THURSDAY, DECEMBER 9, 1915.

NATIONAL NEEDS.

HIS MAJESTY THE KING, at the opening of the Congress of Applied Chemistry held in London six years ago, made the following notable remark :—

"I fully appreciate the important part which chemistry plays in almost every branch of our modern industry. We all recognise that without a scientific foundation no permanent superstructure can be raised. Does not experience warn us that the rule of thumb is dead, and that the rule of science has taken its place, that to-day we cannot be satisfied with the crude methods which were sufficient for our forefathers, and that those great industries which do not keep abreast of the advance of science must surely and rapidly decline?"

Little heed was given to this warning then or since, and it has needed the most terrible war of any time, in which all the resources of science and the capacity for scientific organisation are brought into action, to awaken the nation partially to a sense of the strength of the forces which natural knowledge provides, either to build up or to destroy. Attention is necessarily concentrated at present upon the mobilisation of science and invention for military and naval purposes, but we must prepare for the unrelenting industrial war which will follow the conflict of arms; and the only sure way of doing this is to put into practice the sound principles to which the King gave utterance in 1909, and which we have persistently urged upon a couple of generations. If the country is not placed in a position to face all competition with confidence, it will be because Ministers of State and manufacturers continue to disregard British genius for original scientific work, and neglect to offer sufficient inducements for its development.

The first thing needful is to change the attitude of the general public towards science from that of indifference to one of intelligent interest, by making all education more scientific. When this has been accomplished, ignorance of scientific methods on the part of municipal and State officials will not be tolerated, and the Ministry of Science, which Sir William Crookes adumbrated in his presidential address to the Royal Society last week, will come within the realm of practical politics. Such a Ministry or Board would secure the organisation of our scientific forces to the national advantage, and would, as Sir William Crookes said, make scientific research "an invaluable profession, with a status of its own at least on a level with that of other learned professions." Our scientific and industrial history shows that we are second to none in capacity for original work and invention, but the State has neglected its duty to organise the powers it thus possesses, and only lately has it done anything to promote co-operation between manufacturers and scientific workers, by the appointment of the Advisory Council on Scientific and Industrial Research.

We have had before us recently several papers and addresses, by men of distinguished eminence, in which reference is made to British and German attitudes towards scientific work, particularly as regards its relation to chemical industries. Dr. C. F. Juritz, in his presidential address to the third general meeting of the South African Association of Analytical Chemists, held on July 9, took as his text the general ignorance which is shown by the State and the great mass of the population of the British Empire as to the work of the chemist. In consequence of this ignorance the remuneration paid to the trained chemist, especially to those occupied in industry, is, on the whole, miserably inadequate; with the result that the best men are driven to apply their talents in other fields of work. It is primarily her appreciation of the value of her scientific workers which has placed Germany in the forefront of modern industry. Britain is suffering in the present war because of her neglect of those very services which Germany has done so much to foster. Science has a right to look for more recognition on the part of Government and a greater scope for her activities; the scientific worker for better prospects of obtaining good remuneration so that he can pursue his work without harassing anxiety as to ways and means. It is owing to the highly specialised character of his work that the chemist has received less public acknowledgment than workers in any other profession, yet chemistry and related sciences lie at the base of most industries.

Dr. L. H. Baekeland, in an interesting address on applied chemistry which appeared in *Science* of October 22, reiterates the statement which has been frequently emphasised in our columns: that a chemist is not a druggist, or even a mere analyser of chemicals, but a scientific man upon whom, if he is adequately trained, the advance of the big scientific industries of the world rests; and, further, that the economic welfare of our

country and the health of its citizens are largely dependent on the way chemical knowledge is used. The present war has done much to give to the chemist his true function in national economics. It has been called "a chemical war" because every department of the fighting armies, from the Red Cross service to the manufacture of guns and explosives, involves chemical knowledge incessantly. It has shown us also some results—direct and indirect—of State neglect to promote the development of scientific industries.

On account of the war, there has been a shortage of artificial dyes and synthetic products in the United States as well as in this country, and steps have been taken in each case to increase the home supply. It may be held, with Dr. Baekeland, that the attention given to these products is out of proportion to their commercial value, which only amounts to 1,800,000*l.* of German imports in the States, whilst the national industries, which include the manufacture of sulphuric acid, the phosphate industry, the manufacture of dynamite, glucose, electrolytic copper refining, production of aluminium, calcium carbide, alkalis, and bleaching powder, are decidedly more imposing in value than the few million imported coal-tar dyes. The national value of an import must not, however, be measured by the purchasing value alone. British industries use annually dyes to the value of nearly 2,250,000*l.*, of which about 1,750,000*l.* have come from Germany, but these dyes constitute an indispensable material in many branches of the textile, leather, paper, and other industries, and the annual value of the goods in which they are an essential or important part is estimated at 200,000,000*l.*

We can be independent of all supplies of synthetic products from abroad if we wish. In industry, science, and invention alike England has led, and can lead, both Germany and the United States. This general thesis was developed by Dr. Dugald Clerk in an inaugural address at the Royal Society of Arts on November 17. Germany with its order and method is compared with "unpractical, illogical, idealistic, laughing England"; and it is claimed, following Buckle, that we are successful because the English brain is inductive, while the German brain is deductive. Dr. Clerk shows that we have abundant reason to be proud of our national achievements; and even if the case for British ability is over-stated, it is a refreshing contrast to the reverse side of the picture often presented; the truth should probably be sought in some intermediate position.

Germany has produced few men of great eminence as originators—far less than Britain or France—but she has a very large number of men of more than average capacity; and, above all, Germany alone has discovered how to make the best use of these by organisation and co-operation. This is the keynote of her success.

Various explanations have been given from time to time to account for the present unsatisfactory position of certain of our chemical industries, such, for example, as the discouraging patent laws, the duty on alcohol, the difficulty of financing improved processes, and the lack of research chemists. Actually the root of the mischief, as Sir James Dewar emphasised in his address to the British Association in 1902, is in the want of education primarily among our so-called educated classes, and secondarily among the workmen on whom these depend. The commanding advantage of Germany is in the abundance of men of ordinary plodding ability, thoroughly trained and methodically directed. It is a fortunate thing for a country to produce inventors, but it profits little if the invention is first converted into a paying proposition by the methodical organisation of the workers in another land! More than one recent statement testifies to the fact that this has actually happened. Proud as we are of our British inventors, it is time that it was realised that we as a nation are losing the faculty of going into the works and applying the invention under the stern conditions of commercial competition.

The advantage gained by the German population owing to the position it has reached in point of general training and specialised equipment will be difficult to overcome. Our great national asset is the power of dogged determination, which never acknowledges defeat. This, coupled with the readiness to accept responsibility, and to take initiative, which characterise so many of the younger men of our upper classes, has led to the establishment of our great Empire. If it is possible to combine scientific knowledge with these national attributes so as to produce and organise the constructively trained mind, the future can be faced with confidence. The difficulties are great, particularly by the opposition of vested interests, the inordinate amount of attention given to sport and pleasure by all classes, and a natural conservatism fostered by neglect of science in education; but the reward is greater still.

THE CHLORINE INDUSTRY.

Manuals of Chemical Technology: iv., Chlorine and Chlorine Products. By Dr. G. Martin. Pp. viii + 100. (London: Crosby Lockwood and Son, 1915.) Price 7*s.* 6*d.* net.

IN the book before us, the fourth of a series of manuals of chemical technology which are being published under the direction of Dr. Geoffrey Martin, the editor gives a concise account of the present condition of the chlorine industry, and of the applications of this substance to the manufacture of bleaching powder, hypochlorites, chlorates, perchlorates, etc., and of its use as a chlorinating agent; with short sections on the manufacture and industrial uses of bromine, iodine, hydrochloric and hydrofluoric acids; and, by way of appendix, a chapter of some half-dozen pages, by Mr. G. W. Clough, on recent oxidising agents—of no very direct connection with the main subject-matter of the book.

It is scarcely to be expected, in a book of 100 octavo openly printed pages, with much of the space occupied by illustrations, that more than the very slightest and most superficial treatment is possible, wholly incommensurable, it must be admitted, with the enormous commercial importance of the subject. At the same time, the little work contains a considerable amount of information, and as an *aperçu* of the contemporary state of the relations of the halogens to chemical industry, it is interesting, and not without value to the student who desires only a general acquaintance with the trend of recent developments in chemical technology. For fuller information the reader is referred to special or larger treatises, the titles of which are given as headings to the several chapters. Indeed, the bibliographies and patent lists, as in the case of the other members of the series, are among the most commendable features of the book. It must be stated, however, that a considerable number of these references are to German sources, altogether inaccessible to the ordinary reader, or even to the majority of those specially interested in the subjects.

During recent years a radical change has come over the manufacture of chlorine, and in all probability at least one of the processes which have originated in this country, and which in its day effected nothing less than a revolution in the alkali trade, is doomed ultimately to extinction. The Weldon process, which at its inception may be said to have saved the position of the Leblanc soda industry, at one time threatened by the rapid development of the ammonia-soda process, has now reached apparently its full extension, and makes no further progress. On the other hand, the competing process of Deacon and Hurter, thanks to the mechanical improvements introduced by Hasenclever and to the elaborate investigations of Haber, Lunge and Marmier, Vogel von Falckenstein and others, on the thermodynamical problems involved, and on the specific action of various "contact agents," still holds its own, and is stated to be even advancing, in spite of many technical difficulties only to be overcome by skill and intelligent management. But it may be doubted whether even this process will ultimately survive the competition of electrolytic chlorine.

The application of electrolytic methods to chemical manufacture has received great development in America and in Germany, but, although there are a few notable exceptions, there has been no corresponding activity on the part of our chemical manufacturers, and the subject scarcely receives the attention it deserves in our technical schools and colleges. The Imperial College of Science and Technology, we believe, made a belated attempt to establish a course of instruction on industrial electrolytic methods—a matter of the greatest importance to the future of our chemical industries, but apparently it was in advance of any public recognition of its vital necessity. Some idea of the growing importance of electrolytic chlorine may be gleaned from the fact that, before the war, Germany produced nearly seven-tenths of the amount she needed by this process. All the important methods of manufacturing electrolytic chlorine and alkali of which published accounts are available are mentioned, and shortly described, in Dr. Martin's monograph, with explanatory diagrams, together with a statement of what is known respecting their current and energy efficiencies.

The manufacture of liquid chlorine has a special interest at the present time, and, as is now well known, large quantities of this substance are made in Germany by the Griesheim process, and, to some extent, in England by the Castner-Kellner method. Owing to the circumstance that dry chlorine does not attack iron, the liquefied gas can be transported in large boilers or steel cylinders. Apart from its use in warfare, it finds extensive application in the manufacture of monochloroacetic acid in the synthetical indigo industry, and as a chlorinating agent in the production of chloroform, chloral, and other organic substances. The account by Dr. Martin of the process of liquefaction gives only a partial and imperfect account of the methods actually employed. Even more bald is the description of the methods of manufacture of the alkali chlorates and perchlorates. Apart from the bibliography, it is scarcely fuller than would be given by an intelligent and reasonably well-

informed student in answer to an examination question. Of more importance is the chapter on bleaching powder and hypochlorites, and the description of recent methods of electrolytic bleaching is of special value. There can be no question that these methods are destined to effect a fundamental change in our textile industries. Already they have displaced a considerable amount of bleaching powder, and their application is rapidly extending, especially on the Continent, where the plants of Schuckert, Kellner, and Oettel are largely employed.

The chapters on the manufacture of hydrochloric acid, bromine, and iodine present no special features of novelty. Until the outbreak of the war practically the whole of the European supply of bromine came from the Stassfurt deposits, but large quantities are now finding their way into commerce from America. The mineral springs of Ohio contain nearly four times the amount of magnesium bromide that is present in the mother liquors obtained from carnallite. The account of the iodine industry is mainly abstracted from Prof. Henderson's article on that subject in Thorpe's "Dictionary of Applied Chemistry." The short chapter on hydrofluoric acid is of interest as showing the increasing commercial importance of this substance, not only in etching glass, but in the purification of graphite from silica, in dyeing, and in the spirit and brewing industries.

The final chapter on peroxides and peracids gives a short description of the more technically important peroxides of the alkalis and alkaline earths, which come into commerce as "oxone," "oxylith," etc., and the various perhydrols, including hydrogen peroxide. The account of the peracids and their salts deals with the so-called persulphuric acid and permonosulphuric acid (Caro's acid) and the persulphates of the alkalis; sodium perborate (used in certain "dry" soaps and as a washing and bleaching agent); and the alkaline percarbonates. These substances have at present only a slight technical importance, but their use is gradually extending.

OIL SEEDS AND THEIR PRODUCTS.

The War and New British Industries. Imperial Institute Monographs. Oil Seeds and Feeding Cakes, with a Preface by Dr. W. R. Dunstan. Pp. xxiii + 112. (London: John Murray, 1915.) Price 2*s.* 6*d.* net.

IF the war has no other results, it is at least compelling us to examine our affairs in such detail as we have never before attempted, and the examination has brought to light all sorts of curious facts about industries that we ought to have started and did not, and products that we ought to have made for ourselves but purchased instead. Who, for example, would have supposed that the palm-kernel oil used in this country, and grown in British West Africa, had to be pressed out in Germany? It is not to be imagined that the British mills were unequal to the task; but somehow they did not do it, and consequently the outbreak of war threatened West Africa rather seriously. Fortunately, Sir Owen Philipps, the chairman of the West African Section of the London Chamber of Commerce, took the matter up, and equally fortunately the Imperial Institute energetically turned its attention to the whole problem of oil seeds affected by the war. The Institute has already published some important reports on the subject, which are now embodied in the book under review.

The substances dealt with are copra, palm kernels, ground nuts, sesame seed, and mowra seed. All these are produced largely in the British Empire; most of them were sent in great quantities to Germany and Austria, where the oil was expressed, the residues made into feeding cakes for stock (except in the case of sesame and mowra seed), and both these commodities were re-exported to the countries needing them.

The fact only wants stating to compel attention, and Prof. Dunstan has wisely contented himself with a recital of economic uses of the oils and residues, the amounts available, the markets to which the seeds have hitherto gone, and the possibilities of extending the industry. No more eloquent testimony could possibly be adduced to prove the need for establishing this industry in our own country at the earliest opportunity.

The utilisation of oil seeds presupposes two distinct conditions. There must be a demand for the oil, and it must be possible to utilise the residual "cake" left after the extraction. Usually the oil finds application without difficulty. The higher qualities are used for margarine, vegetable butter, olive-oil substitutes, etc.; lower grades for soap-making, lubricating, and illuminating purposes. The residual cake presents a more difficult problem. On the Continent, the copra, palm-nut, and ground-nut cakes are used as cattle food, while the sesame and mowra are unsuitable, and have to find other applications; but in this country the farmer is so well satisfied with linseed and cotton-seed cakes that he sees no reason why he should take up any others. It is here that the crux of the situation lies; the farmer cannot be expected to purchase a product solely for the convenience of the oil mills, nor is it any use trying to badger him into doing so by sending him

pamphlets about food values. The new products must undersell the old ones, and then they will soon begin to find buyers.

Prof. Dunstan and his staff are to be congratulated on the bold way in which they have grappled with the problem and the lucid statement they have drawn up. Already they see some results of their labour; shipments of seeds are beginning to go to Hull to be pressed, and the residues (which alone present any difficulty) have been put under investigation at the various agricultural colleges. Only gross mismanagement can prevent the development of the new industry—unless after the war the Germans again subsidise their own industry so as to extinguish ours, as it is said they did on an earlier occasion when attempts were made to work up the seeds in this country.

E. J. R.

PUBLIC HEALTH ADMINISTRATION.

A Manual for Health Officers. By J. S. MacNutt. Pp. x+650. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 12*s.* 6*d.* net.

IN this country there are numerous manuals of public health, detailing the duties of medical officers of health and other sanitary officers. In the United States we believe the volume here noticed is the first to review public health administration from a practical viewpoint. Part i. is concerned with the organisation and powers of health authorities, part ii. with public health administration.

In a community consisting of separate States, each possessing home rule in sanitary matters, there is evidently much scope for differing regulations. Such differences exist, and we should have liked a fuller statement of the types of legislation and administration than is given in this manual. The information given is, however, clearly set out, and the reader wishing for guidance will find in this book much information in regard to the various classes of service—inspection service, medical service, public health nurse, laboratory service, veterinary service, labour, legal counsel and service.

State organisation is vested in a board or in a commissioner, more often in a board. In Massachusetts this consists of seven persons appointed by the governor, with the advice and consent of his council, for a term of seven years. In New York State, on the other hand, power is vested in a commissioner of health, assisted by an advisory council consisting of two laymen, one sanitary engineer, and three physicians. In both arrangements, democratic control in this reputedly democratic country is indirect and remote, and the medical professions exert a predominant influence. As time passes and experience becomes riper, it will be interesting to compare American city experience with English city experience in sanitary matters. In the latter, as is well known, the electors can more directly and more swiftly influence and alter the constitution of the sanitary authority; and although this sometimes means selfish obstruction to sanitary progress, it necessitates progressive public education in local sanitary administration, and there is seldom serious relapse in progress made. Nor is "graft" so conspicuous in English as in some American cities.

It is remarkable that the States have only in an embryonic stage any central and national health organisation corresponding with that of the English Local Government Board. There is much agitation on this subject; and although the statement sometimes made that "Uncle Sam" spends millions on the health of hogs and little or nothing to promote the health of human beings is exaggerated, it contains a modicum of truth.

The gaps in official administration are much more largely filled up by voluntary associations in America than in this country; and anyone wishing to study the problems of charity, of tuberculosis, of housing, and of child welfare, would need to go largely to these societies for information and for insight into some of the best American work.

Excellent sections of this book are concerned with exploding the sanitary fallacies surviving from an earlier period. The sanitary significance of dirt is stated with discrimination. The limited *rôle* of sewer gas and foul odours is defined; and the error of supposing that running water will more quickly purify itself from pathogenic germs than stagnant water is shown.

Each communicable disease is dealt with in turn, and the succinct advice given is sound and reasonable. The following statement from the section on tuberculosis is the basis on which modern administrative control over this disease is founded. "Experience shows that the normal human system is capable of resisting small doses of infection when it would succumb to a heavier dose, and it is just these heavier doses which supervision over the germ-shedding patient prevents."

In regard to small-pox, it is urged that a hospital for this disease "may be a special department of a regular contagious disease hospital, and, if properly conducted, need not be located at a distance from other habitations. . . . Certainly air infection out of doors is practically nil." This is in direct contradiction to the rigid rule of the

English Local Government Board, which insists on a quarter-mile distance from even a small group of houses.

We have not left space for discussing the chapters on child hygiene, on milk and other food supplies, water supplies, housing, nuisances, sanitary law, and vital statistics; but in each of these the English sanitarian will find useful points for comparison with our own methods. The last chapter deals with publicity; and here is, perhaps, the most characteristic feature of public health work in the States. In relation to the Press, exhibitions, lectures, motion pictures, etc., useful hints are given for bringing home the lessons of sanitation to the general public.

OUR BOOKSHELF.

North America during the Eighteenth Century: A Geographical History. By T. Crockett and B. C. Wallis. Pp. vi+116. (Cambridge: At the University Press, 1915.) Price 3*s.* net.

THE authors have collaborated in an interesting experiment, and have wisely chosen for their first essay (for we presume it is a prelude to others) a region in which the facts of history are easily correlated with those of geography. In one sense it is only another account of the rise of the United States of America, but in a different sense it is a new story, for it tells the history of a century in the light of the place where it occurred. One can imagine oneself in America and watch the drama unfold. We are glad to see that the authors invert the old term and speak of a geographical history, for not only should geography precede history in course of study, but the term historical geography has fallen on evil days so far as school books are concerned. In most cases, except for a preliminary chapter and a map or two, it has no relation to geography.

This book begins with the usual preliminary chapter, but the succeeding ones are not disappointing. The influence of routes and relief, and the question of place relations, are kept to the fore throughout, and very useful are the terse summaries at the end of each chapter. There are many useful black and white maps. In the way of criticism we could wish that the first two maps were a little clearer, and that the authors had curtailed the length of some of their sentences. But we welcome the volume as a most illuminating book. R. N. R. B.

First Aid in the Laboratory and Workshop. By A. A. Eldridge and Dr. H. V. A. Briscoe. Pp. 32. (London: Edward Arnold, 1915.) Price 1*s.* net.

THE authors of this little book, who have been in charge of first aid organisation in chemical and physical laboratories, have found that the ordinary text-books devote too much space to serious fractures and other injuries, but give little information regarding ordinary accidents, such as are apt to occur in laboratories and workshops, for instance, burns produced by chemicals, eye injuries, shocks produced by electric currents, and poisoning. They have therefore written this pamphlet to meet this need. It is prefaced by a commendatory foreword from Sir Alfred Keogh, and we heartily endorse his praise. The directions are terse, clear, and correct.

Determinative Mineralogy: With Tables for the Determination of Minerals by Means of their Chemical and Physical Characters. By Prof. J. Volney Lewis. Second edition. Pp. vii+155. (London: Chapman and Hall, Ltd., 1915.) Price 6*s.* 6*d.* net.

THE present edition differs from the first—reviewed in our issue for January 15, 1914 (vol. xcii., p. 550)—chiefly in the restatement with each table of the classificatory characters and tests leading up to it. The supplementary tables at the end have been extended to include specific gravity and chemical composition; and many more delicate tests have been introduced in both the text and the tables.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Principle of Similitude.

(1) IN his article under the above heading (NATURE, March 18, 1915, p. 66) Lord Rayleigh deduces, by the method of dimensions, an equation for the rate of heat transfer between a solid body and a stream of fluid in which it is immersed. Commenting on this equation, M. Riabouchinsky (NATURE, July 29, p. 591) remarks that heat, temperature, length, and time are treated in the deduction as independent units; and that if we suppose only three of these units to be "really independent" we obtain a different and less definite result.

In a further note (NATURE, August 12, p. 644) Lord Rayleigh acknowledges the interest of the question suggested by M. Riabouchinsky, and indicates the direction in which the solution of the apparent difficulty is to be sought. But since he does not pursue the subject further and the reader may feel as if left in mid-air, it seems worth while that the point raised by M. Riabouchinsky should be somewhat further elucidated.

(2) The question whether any real doubt has been thrown on the validity of Lord Rayleigh's equation hinges on the answer to the question whether temperature can be derived from energy, length, and time, *i.e.* from mass, length, and time.

What do we mean when we say that a given kind of physical magnitude can be "derived" from certain other kinds which we call fundamental? We mean simply that experience has shown that if we use, or combine, certain particular magnitudes of the fundamental kinds in a prescribed way, we thereby determine a magnitude of the derived kind, the size of this resulting derived magnitude being dependent only on the sizes of the particular fundamental magnitudes with which we started, when once the method of using them has been specified. For example, we know that if we construct a rectangle of altitude l on a base l

we thereby determine an area, and we express this shortly by saying: "Area is derived from length." This is all we mean by the conventional term "derivation," and in stating the dimensions of a derived quantity we do not make use of any hypotheses.

Now there is no known process by which, having available only standards of mass, length, and time, we can fix and reproduce any temperature such as the ice point. To do that we require something more—for instance, that the mass shall be a mass of some particular substance having other properties than mere inertia, some one of which may serve as a fourth standard. There is no uncertainty in answering the question referred to at the beginning of this section; whatever Maxwell's demons might do, *we* cannot derive temperature from any three purely mechanical magnitudes. There can therefore be no doubt of the validity of Lord Rayleigh's deduction.

(3) Though the question suggested by M. Riabouchinsky's note is thus answered immediately by an appeal to facts, it may not be amiss to add a few words for those who have fallen into the habit of setting proportionality constants equal to unity and then forgetting all about them.

If we accept the molecular theory, the information it affords on the subject now in hand is that the numerical value of any temperature, on Kelvin's scale, is proportional to the mean molecular kinetic energy of an ideal gas which is at that temperature. We may describe this relation by writing $\theta/\theta_0 = T/T_0$, in which T and T_0 are the molecular kinetic energies at the temperatures θ and θ_0 respectively. Both members are pure ratios, and it is obvious that the equation does not furnish any dimensional relation between θ and T; and yet this equation embodies *all* the knowledge which the molecular theory affords on the matter under discussion. To say that the molecular theory authorises us to "define" temperature as the mean kinetic energy of the molecules, would be quite on a par with saying that a peach may be defined as a shilling because the number of peaches we can buy is proportional to the number of shillings we spend upon them, and, in some states of the market, not only proportional but equal. On our ordinary scale, an interval of time is proportional to the angle through which the earth rotates during that interval; but no one thinks of saying that we may define time as angle, or of assigning to time the dimensions of angle. Proportionality of numerical values does not imply qualitative identity.

As Lord Rayleigh remarks:—"It would indeed be a paradox if the further knowledge of the nature of heat afforded by molecular theory put us in a worse position than before in dealing with a particular problem." In reality, the worse position in which M. Riabouchinsky suggests that we place ourselves, would be due not to utilising further knowledge but to ignoring what we already have.

(4) Cases do occur, though the foregoing is not one of them, in which it seems doubtful, at first sight, how many independent units we ought to use. Such a doubt may arise when we ask ourselves if we ought not to use the law of gravitation to eliminate one of our three mechanical units, or the constancy of the speed of light to derive time from length. The discussion of this subject, which involves the question how we are to interpret "universal constants," must be postponed to a future occasion, but the following hint may be given of the conclusion to which such a discussion will lead.

Suppose that we have n independent simultaneous equations, involving $n+k$ quantities, and that we reduce them to a single equation. Each equation represents a single known fact, and when a given equation has been used once, there is nothing further to be gained by using it again; for only a formal and not a real change in the result can be thus produced. If one of the quantities is known to be constant, it may be removed from the list of variables before starting the reduction. But as regards the final result, it is immaterial whether the constancy of a particular quantity is recognised explicitly at the start or not until the end; the conclusion to be drawn regarding the quantities which do vary is the same in either case.

If, for example, the phenomenon under consideration involves the operation of the law of gravitation, as in Lord Rayleigh's problem of the vibration of liquid globe (NATURE, March 18), one of the facts of the problem is expressed by the equation $f=\gamma mm'/r^2$. We may treat the gravitation constant γ as one of the physical quantities involved in the problem, and use this equation to find its dimensions $[\gamma]=[m^{-1}l^3t^{-2}]$; or we may treat γ as a pure number and use the equation to eliminate one fundamental unit by setting $[m^{-1}l^3t^{-2}]=[1]$; but we cannot do both. The final result is in either case that given by Lord Rayleigh.

E. BUCKINGHAM.

Washington, November 23.

Grime's Graves Flint Mines.

PREHISTORIC archæologists will be grateful for the excellent account given in NATURE of November 18 of the report recently published by the Prehistoric Society of East Anglia on the excavations conducted in 1914 at Grime's Graves, Norfolk. It is evident that your reviewer regards the flint implements found at this site as referable to the Neolithic period, and while this view may possibly be correct, the present writer is of the opinion that a close and dispassionate study of the specimens recovered, and of the exhaustive report prepared by Mr. Reginald A. Smith, will not tend to foster any feeling of certainty on this point.

The question of the age of the flint implements found at Grime's Graves is of great importance, and can only be fully and adequately dealt with by experts in prehistoric archæology. The contributor of the article in NATURE is evidently a geologist, and I venture to enter a protest against his taking an authoritative part in the discussion on a technical subject altogether outside the realm of geology. Unfortunately, it does not seem to be generally recognised that the study of flint implements is of a highly complex and difficult nature, requiring as much, if not more, detailed knowledge than is required in many other sciences. The geologist would object, and rightly so, to a prehistorian giving an authoritative opinion upon a question of geology; the archæologist simply asks for a like immunity from inexpert criticism of his particular subject. Your reviewer has every right to give an opinion on the geological problems presented by the excavations at Grime's Graves, and there can be little doubt but that his opinions must carry weight. But the flint implements present a problem that can only be discussed with any profit by experts in prehistoric archæology.

J. REID MOIR.

12 St. Edmund's Road, Ipswich.

I inferred from the report of the "experts in prehistoric archæology," that if the various flint implements met with at Grime's Graves had been found separately in different localities, they would have been referred "authoritatively" to several successive periods of human culture. To aid them in dealing with this strange admixture of supposedly distinct industries, I merely pointed out that the geological evidence, so far as discovered, is perfectly harmonious and conclusive, showing that the deposits cannot be older than the Neolithic period.

A. S. W.

DISCOVERY OF A SKELETON OF ELEPHAS ANTIQUUS *AT UPNOR, NEAR CHATHAM.*

THREE or four years ago a party of Royal Engineers was digging a trench on the banks of the Medway at Upnor, opposite Chatham Dockyard. In the course of their work they came across a number of large bones, some of which were destroyed together with a tusk of great size; at this point they suspended operations. Some time later Mr. S. Turner, of Luton, was collecting flint implements in the neighbourhood and picked up some pieces of bone, which he sent to the Natural History Museum for identification. One of these pieces was recognised as being a carpal bone of a large elephant, and in the autumn of 1913 it was decided to examine the spot in the hope that further remains would be found. From this examination it became clear that a considerable portion, at least, of the skeleton of a very large elephant still remained buried in the clay, and a few bones, including an enormous axis vertebra, were collected. The weather then becoming very wet, operations were discontinued and, for various reasons, not resumed till the past summer. Then, after arrangements had been made with the military authorities, the work of excavation was renewed, and was carried on until there was no hope of further discoveries.

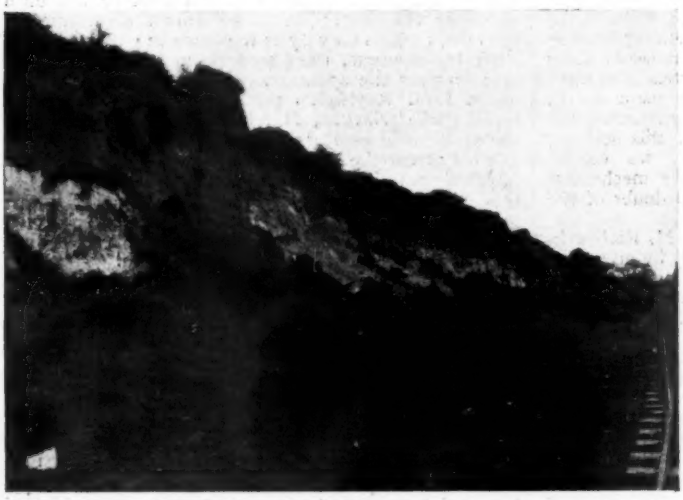

FIG. 1.—Section at Upnor showing chalk below with Thanet sands above; the alluvium in which the bones occur was depo-ited against these. The actual spot where the skeleton was found is at the far end of the section.

The bones were in an extremely fragile condition, and in many cases were so near the surface that they were perforated by the roots of the vegetation growing above them and by worm-burrows. The method of extraction is shown in Fig. 2. The upper surface and edges were first exposed and then completely covered with a series of strips of coarse canvas dipped in plaster of Paris; next the specimens were undercut and turned over, when the encasing process was completed. This work was skilfully carried out by Mr. L. E. Parsons, jun., and thus a large part of the skeleton was safely removed.

The chief portions collected are a tusk about 8 ft. long, portions of the skull and mandible (very imperfect) with one lower and two upper molars in very good condition, numerous vertebræ, and sufficient limb bones of one side or the other to render it possible to restore the fore- and hind-legs almost completely. The teeth indicate that the animal is *Elephas antiquus*, and the discovery is of especial importance because this is the first instance, in this country, at least, in which teeth and a great part of the skeleton have been found in association. Hitherto there has always been uncertainty as to whether bones found were certainly those of *E. antiquus* or not; now it will be possible to give a nearly complete account of the osteological characters of that species.

FIG. 2.—Showing an os innominatum and a femur in process of extraction.

The limb bones indicate that the animal was of enormous size, comparison with bones of an

African elephant of known height showing that it probably stood 15 ft. at the highest part of the back. Thus the humerus is 4 ft. 4 in. in length, while the humerus of an African elephant said to have been 11 ft. 4 in. high is a foot less. The beds in which the bones were found consist of a series of sandy clays and tough clay with numerous flints, much race and ironstone. These were deposited against the side of a slope composed of chalk below and Thanet sands above (Fig. 1). Their exact age is doubtful, but probably they are nearly contemporary with the bone-bearing beds of Grays or perhaps earlier. The molar teeth seem to have belonged to an early form of *Elephas antiquus*, and closely similar to some discovered at Mosbach.

During the excavation the military authorities gave every possible assistance, and without their help the work would have been much more difficult, if not impossible. The specimen has been presented to the British Museum by the War Department. The bones are now being freed from their wrappings and hardened, but it will be some time before they will be ready for exhibition.

CHAS. W. ANDREWS.

BACTERISED PEAT AS A FERTILISER.[1]

THE horticultural world has been interested for some years in Prof. Bottomley's attempt to prepare a new fertiliser from peat. The reasons for that interest are manifest: farmyard manure is constantly increasing in price and decreasing in amount; and artificial fertilisers, excellent auxiliaries though they be, cannot impart to the soil those physical properties without which plants do not thrive.

The market grower, accustomed to raise heavy crops on land treated with enormous dressings of manure—100 tons or more to the acre—is only too anxious to discover other and less costly means of enriching his soil; and even the general public—if we may judge from the attention which is being bestowed in the daily Press on Prof. Bottomley's discoveries—is alive to the importance of increasing the fertility of the land. Hence the spirit of the soil manifests itself opportunely in conjunction with the spirit of the times. It purports to reveal the mystery of the mode of action of bacterised peat—the fertiliser which Prof. Bottomley prepares from peat-moss litter and from certain kinds of raw peat.

Mr. Knox, the author of this volume, has done his work well. He tells his story graphically yet simply, although in chapter ix., entitled "Elementary Conceptions of Chemistry, etc.," he showers a rain of atomic bombs on the reader with such effect that that much-enduring person will doubtless seek cover in the next chapter.

Briefly, this is the story that Mr. Knox has to tell. Certain aerobic bacteria possess the power of liberating from peat large quantities of soluble humates. These soluble humates are in themselves of service to plants as sources of food. They serve, moreover, as a culture-medium in which nitrogen-fixing bacteria—azobacter chroococcum, etc.—multiply rapidly. Hence by adding cultures of nitrogen-fixers to sterilised humated peat, the amount of nitrogen in the latter is increased.

It was to this large nitrogen content that Prof. Bottomley originally attributed the fertilising powers of bacterised peat. Tests carried out at Kew on many different kinds of greenhouse plants—lilies (see Fig. 1), cyclamen, coleus (see Fig. 2), primulas, etc.—indicate in most striking manner that the addition of bacterised peat to a potting compost brings about a great increase of growth and vigour. The amount of bacterised peat (or humogen, as it is sometimes and somewhat inconsequently called) which produces these results is about 10 per cent. of the total compost.

FIG. 1.—The left of the two lilies shown in the illustration was grown in humogen and ordinary soil, while that on the right was grown in a complete food compost. The average number of blooms on the batch (48 size pots) was six as against four, and it should be noted that this is the common effect of humogen treatment on bulbs. (The Royal Gardens, Kew). From "The Spirit of the Soil."

Anyone who takes the trouble to reckon what 10 per cent. means in tons per acre will recognise that, unless far smaller dressings of bacterised peat may be used, this fertiliser cannot be applied with success to field crops; and indeed, in certain field experiments which we have witnessed the addition of dressings of bacterised peat at the rate

[1] "The Spirit of the Soil." By G. D. Knox. Pp. xiii+242. (London: Constable and Co., Ltd., 1915.) Price 2s. 6d. net.

of two tons to the acre produced no beneficial results.

Pot plants treated with bacterised peat show, as compared with controls, not only increased growth but sturdier habit and greater root-development. This fact led to the suggestion that the phenomena cannot be attributed solely to the nitrogen-content of the fertiliser. It is, for example, a well-known fact that the addition of phosphorus-containing fertilisers brings about the development of a more vigorous root-system than is produced in soil poor in available phosphates.

Following up the suggestion that the virtues of bacterised peat are to be sought elsewhere than in the nitrogen contained in the fertiliser, Prof. Bottomley was led to the very interesting conclusion that the growth of plants is conditioned not only by the well-known substance-producing

FIG. 2.—Two specimens of coleus grown at the Royal Gardens, Kew. The right-hand plant received humogen, while the left had the usual potting compost. From "The Spirit of the Soil."

food materials, but also by hitherto unknown growth stimulators. These substances, which he claims to have isolated from peat, Prof. Bottomley has called auximones. He believes that they play a part in plant-nutrition somewhat similar to that played by accessory food bodies in the nutrition of animals.

Like Prospero, who at first called up the wrong kind of spirit, but succeeded on a second attempt, Prof. Bottomley's wand first evoked nitrogen, but now waives that heavy apparition in favour of a more delicate, Ariel-like auximone. Auximones are "it," in the vulgar parlance of the day, or in the more elegant language of Mr. Knox they are the spirit of the soil.

Prof. Bottomley brings forward evidence in favour of the existence of auximones and of the important part they play in activating the growth of plants. It is, however, in no hypercritical spirit that we confess that the evidence does not appear to us strong enough to bear its burden. Biologists need no reminder of the pitfalls that beset their attempts to establish hypotheses by the method of comparison. Although often the only method at our service, it is a very clumsy one; and in a subject of such importance as the existence of a new type of food substances, the evidence must be overwhelmingly strong before the hypothesis which it supports may be accepted.

We do not think that Prof. Bottomley's evidence is strong enough to support this test. Nevertheless, it should not be dismissed lightly; rather is it a case like so many in biological science, in which a just judge would order a fresh trial. We understand that such a trial is to be conducted at Rothamsted, and we hope, for the sake of horticulture and agriculture, that it may lead on one hand to the demonstration of the fertilising value of bacterised peat, and on the other to the just judgment of the case for auximones.

FREDERICK KEEBLE.

DYSENTERY AND WAR.

DYSENTERY is a term embracing several varieties of intestinal flux. Anatomically there is inflammation, and frequently ulceration of the large bowel. Owing to improved sanitary conditions the diseases described under dysentery have become infrequent in this country, though outbreaks occasionally occur, particularly in overcrowded institutions. In the past, however, widespread epidemics have prevailed, notably one which raged between 1847 and 1856; and in the tropics dysentery still deserves its

reputation as being one of the most destructive of diseases.

Dysentery, moreover, is one of the great diseases attacking camps, and has been more destructive to armies than powder and shot (Osler). In the Federal service during the Civil War, according to Woodward, there were 259,071 cases of acute and 28,451 cases of chronic dysentery, and the disease prevailed widely in the South African campaign, in the Franco-German War of 1870, in the Crimean War, and even before the Battle of Agincourt in 1415. In the present campaign, too, dysentery has prevailed both in the Western and Eastern seats of war—in Gallipoli, for example, in the course of a few months some 78,000 men were invalided on account of sickness, a large proportion of whom suffered from this disease.

The two principal types of dysentery are the amœbic and the bacillary, due respectively to an amœbiform protozoon and to a group of closely-allied bacteria, the dysentery bacilli. Amœbic dysentery or "amœbiasis" is essentially a disease of the subtropical and tropical regions of the globe, and is widespread over the continents of Africa, Asia, and America, and is particularly common in Egypt and India. The causative parasite, the *Entamoeba histolytica,* is met with as an organism resembling an ordinary amœba in the mucus passed in the acute stage of the disease, and in the liver abscesses which frequently complicate the disease. In this stage it is actively motile, and has a diameter of 1/1000–1/600 in. It has also an encysted resting stage, found in the intervals between attacks and in latent cases.

Bacillary dysentery, on the other hand, is of world-wide distribution, and is apt to occur in epidemics, thus differing from amœbic dysentery. Ogata first isolated and described a dysentery bacillus in Japan; this was followed by researches by Shiga in the same country in 1898, and by Kruse in Germany. They proved that the bacillus is a specific one, and it was shown later that it was the same bacillus which is now known as the *Bacillus dysenteriae* of Shiga and Kruse. Later other varieties were isolated by Flexner and by Strong in the Philippines, and by Hiss and Russell (the Y-bacillus).

In England at the present time outbreaks of dysentery chiefly affect asylum populations, and these are almost always caused by the *Bacillus dysenteriae* of the Flexner type. In one asylum outbreak in England and in an epidemic in Scotland Shiga's bacillus has been isolated.

Almost all the cases of dysentery returning from Gallipoli are of the bacillary variety, and the experience of Ledingham, Penfold, and Woodcock[1] appears to show that the infection is chiefly with the Shiga bacillus, while in a smaller number the Flexner bacillus is present. From the eastern Mediterranean a few cases of infection with the *Entamoeba histolytica* have been reported. Among the French in the Argonne the large majority of the numerous cases occurring there are due to the Y-bacillus of Hiss and Russell. In the Germany army on the west front cases due to the Flexner bacillus are reported, while among the Austrians infection with the Shiga bacillus is met with.

In the treatment of amœbic dysentery emetine, an alkaloid of ipecacuanha, is practically a specific, and for the bacillary form anti-dysentery serum is very successful.

Outbreaks of dysentery in armies raise many important problems for the sanitarian. The disease is partly water-borne, though, of course, there is considerable opportunity for direct contamination of food and person in camp and trench life. The intestinal evacuations of cases contain vast numbers of dysentery bacilli and, unless disinfected, infect the locality, particularly the trenches and their neighbourhood, where the men are attacked before removal to hospital, while infection may be spread far and wide owing to the fact that the bacillus does not necessarily disappear from the patient with the onset of convalescence, but may remain in the body for a long time after cessation of symptoms, so that the "carrier" state becomes established. It would probably be desirable to regard a case as possibly infective for a period of three months after the termination of the attack, but the exigencies of war may prevent such a course. Bacteriological examination ought also to be carried out so far as possible to determine when an individual has ceased to be a "carrier."

At present a high standard of general and personal hygiene is the best preventive of the disease. Attempts have been made to introduce preventive inoculation against bacillary dysentery, but with what success is not yet known.

R. T. HEWLETT.

[1] See *Brit. Med. Journ.*, November 13, 1915, p. 704.

OILS AND FATS AS WAR SUPPLIES.

THE discussion in the House of Commons last week, on the export of oils to neutral countries bordering on Germany dealt with a matter on which scientific knowledge might have been brought to bear with great national advantage.

There is no doubt that fats are the one material that a country situated in northern Europe must procure from without; indeed, the price of oils current in Germany affords complete testimony of the accuracy of this statement. Fats are of value for two purposes: first, as an altogether indispensable article of food, and, secondly, as a source of glycerine, which is converted into nitroglycerine and becomes an ingredient of all propellent explosives. Apart from tallow, and perhaps some small amount of linseed, Germany produces no other fat, and her stocks could have lasted but a limited time only. The deficiency has been made up by imports from tropical lands through neutral countries, which, so long as we have control of the seas, can only be obtained by favour of Great Britain.

One by one restrictions have been placed on

the export from British ports of the more obvious fatty materials used as food, but the fact that oils contain glycerine seems to have been largely overlooked, though the belated announcement made last July by Sir F. E. Smith, then Solicitor-General, that "it had recently (!) been discovered that glycerine could be made from lard" must not be forgotten. Some oils or oil-yielding materials are still being allowed to go to neutral countries; for example, linseed or linseed oil, and palm kernels, have been exported to Holland; whale oil is being largely shipped to Norway. Linseed oil, which was formerly only of use as a drying oil, can now be saturated with hydrogen and converted into a hard, white fat suitable for use in margarine. The same applies to whale oil; and there is a very large factory in Norway engaged in this work.

It was claimed in the debate that it is necessary to send these oils to Holland in order that cheap margarine may be returned to Britain. If this be so, the question arises whether all that is possible has been done to protect and foster our own margarine industry, and if the English output of margarine is at its maximum. The answer is probably in the negative—the English maker is short of labour and he is being undersold by his foreign rivals, who are making huge profits in the German markets.

PROF. C. R. ZEILLER.

CHARLES RENÉ ZEILLER, whose death after a long illness was announced from Paris a few days ago, was a member of the Institute, chief engineer of mines, and professor of palæobotany in the National School of Mines. Despite the heavy claims of official duties, Zeiller devoted himself to palæobotanical investigation for nearly forty years. His earlier papers dealt with the Carboniferous and Permian plants of France, and the most important of these is the volume, published in 1878, on the plants of the French Coal Measures. The beautifully illustrated and scholarly monographs of Palæozoic floras, including those of Valenciennes, Commentry (in collaboration with the late M. Renault), Autun, Brive, Creusot, and Blanzy, are models of scientific exposition and thorough workmanship. The two volumes on the Rhætic flora of Tonkin, published in 1903, are the most important of his contributions to the botany of the earlier phase of the Mesozoic era. He also wrote several papers on later Mesozoic plants from different parts of the world, and added considerably to our knowledge of the Permo-Carboniferous floras of South Africa, Brazil, and India, both by his description of new types and his masterly treatment of the wider problems presented by the so-called Glossopteris flora of the southern hemisphere.

Though mainly concerned with impressions of Palæozoic and Mesozoic plants, Zeiller's researches into the structure of the Palæozoic fern Psaronius and, more recently, his work on the anatomy of Lepidostrobus bear witness to his skill as a morphologist. For many years he contributed to the *Revue Générale de Botanique* a critical and comprehensive survey of recent palæobotanical literature; the enormous amount of work represented by these articles illustrates his untiring energy and his unselfish devotion to the subject which he loved. In 1905 Zeiller was elected a foreign member of the Linnean Society, and in 1909 he received the same recognition from the Geological Society of London. In the latter year he visited England for the first time to attend the Darwin celebration at Cambridge, and was one of the distinguished band of foreigners upon whom the University conferred honorary degrees.

Zeiller had a remarkably wide and accurate knowledge of his subject. He was much more than a learned systematist; while scrupulously accurate in his exceptionally lucid descriptions, he always took a broad view. He had the power of synthesis as well as that of analysis. He never wrote too much, and all that he did bore testimony to his courtesy, singleness of purpose, and modesty. Zeiller was a man of simple dignity and great personal charm; his death is a severe blow to a department of knowledge which claims a comparatively small number of students. He leaves a rich legacy of scientific achievement to a younger generation, and to his friends the stimulating memory of a noble character.

A. C. SEWARD.

PROF. F. R. BARRELL.

BY the sudden death, on December 2, of Prof. F. R. Barrell, at fifty-five years of age, the University of Bristol has lost one of the senior members of its staff. After graduating at Cambridge (Math. Trip., 1882, 14th wrangler; Nat. Sci. Trip., 1883) and in London University (B.Sc., 1884), he was for two years lecturer in Hammond Electrical College and for five years instructor in natural science in the *Britannia*. In 1890 he was appointed lecturer in mathematics in University College, Bristol, and was given the status of professor in 1893. When the University College was merged in the University of Bristol he was elected Dean of the Faculty of Science, and was one of the representatives of Senate on Council. At the time of his death he was Dean of the Arts Board, and again a member of Council.

Sound, especially in fundamental conceptions, rather than brilliant as a mathematician, his main interests lay in the application of mathematics to practical problems in physics and in methods of teaching, with constant insistence on the importance of a securer basis clearly and adequately grasped. His work bore fruit in its influence on those whom he trained. In his earlier days he wrote on electrical problems ("Electricity and Magnetism," 1894), and later on "Elementary Geometry" (1904). He was a pioneer in the localisation of a needle or bullet by

taking two photographs by X-rays on the same plate. Its position, including its depth, was worked out from the photograph by an elegant geometrical construction. He reduced the method to sufficient simplicity for its general use by surgeons, and it has proved of great value when the bullet is deeply and awkwardly placed. He used this method at Netley, where he served as expert adviser during his last long vacation. His offer to resume his work there during the coming Christmas vacation was accepted in a letter which reached his house shortly after his death.

His sincerity and loyalty, his ever-ready sympathy, and his faithful discharge of the many duties he gladly undertook, endeared him to his colleagues and to many generations of students, who were quick to recognise and to appreciate his worth. A man of strong convictions, and one who had the courage fearlessly to uphold them, he won the admiration even of those who differed from him. Within the University, and far beyond its precincts, he was rich in the friendship which attaches to characters such as his. He leaves a widow, who has shared with him the affection and esteem in which he was held, and two sons, who now hold commissions in the Army.

NOTES.

BY the death of Mr. Henry Eeles Dresser, from heart failure, at Cannes, on November 28, at the age of seventy-seven, ornithology has lost one of its most distinguished students. Attracted to the study of birds from his early boyhood, Mr. Dresser devoted the leisure hours which he could spare from the arduous duties of a city life to the elucidation of the avifauna of the Palæarctic region, and gave up his well-earned holidays to extensive travel in Europe, Asia, and America in prosecution of his favourite study. He made his first contribution to scientific literature in the pages of the *Ibis* in 1865, and for a period of almost fifty years he continued to write on ornithological subjects in that journal and in the Proceedings of the Zoological Society. His most noteworthy contributions to ornithology are, however, his "History of the Birds of Europe," in eight quarto volumes, 1871–81, followed by a supplementary volume in 1895–96; "A Monograph of the Meropidæ," 1884–86; "A Monograph of the Coraciidæ," 1893; "A Manual of Palæarctic Birds," 1902–3; and "The Eggs of the Birds of Europe," in two volumes, 1910. For the purposes of these monographs he gradually acquired a magnificent collection of the skins and eggs of Palæarctic birds, now in the Manchester Museum, each specimen in which is fully authenticated and adequately labelled. The care with which he attended to these matters has rendered his collection one of the most valuable in the country. His work is marked by thoroughness, rigid accuracy of description, and careful attention to detail, while the coloured plates, made mainly from drawings executed by Joseph Wolf and J. C. Keulemans, illustrating his monographs are among the most beautiful and accurate in ornithological literature. Ornithology is indeed the poorer by his death.

WE regret to announce that Dr. Robert Caird, of Messrs. Caird and Co., shipbuilders, Greenock, died suddenly of heart failure on December 1, in his sixty-fourth year. We are indebted to Prof. A. Gray for the following appreciation of his activities in scientific fields:—Dr. Caird was well known as an engineer and naval architect, and for many years had been recognised as one of the leading authorities on marine engineering and the construction of ships. After some time spent in America, at the works of the Pullman Car Company, he joined in 1888 the firm founded by his father (who in his day was a leading Clyde shipbuilder), and, with his brothers, Patrick and Arthur Caird, built nearly all the present vessels of the Peninsular and Oriental Company's fleet, and many other great liners. From 1899 to 1901 Dr. Caird was president of the Institution of Engineers and Shipbuilders in Scotland, and he was also a fellow of the Royal Society of Edinburgh. In 1900 the University of Glasgow conferred on him the honorary degree of doctor of laws for his services to applied science. But it is perhaps not so widely known that Dr. Caird was keenly interested in pure science, especially applied dynamics, and did much in many ways to promote its progress. About thirteen years ago he entered *con amore* into the movement for the better equipment of the University of Glasgow; his firm gave a large subscription to the fund, and Dr. Caird himself took a very special interest in the foundation and equipment of the splendid new Natural Philosophy Institute, which was one of the results of the movement. To every detail of that building he gave the most careful attention, and the Natural Philosophy Department owes much to his practical interest and generosity. He had previously been an active member of the committee of Clyde engineers, to whom the University is indebted for the erection and equipment of the James Watt Engineering Laboratories.

MR. C. J. WOLLASTON, who died recently at ninety-five years of age, was not personally well known among the younger generation of present-day telegraph engineers, for he retired from active work fifteen years ago with a well-merited recognition of his services in the introduction of submarine telegraphy. His name, however, will go down to posterity as that of a member of the small company to which was transferred the concession granted by Louis Napoleon for laying a telegraph line under the English Channel. He was one of the engineers in charge of the operations on the *Goliath*, which started on August 28, 1850, from Dover to lay the line thence to Cape Grisnez, and reached its destination in the evening, from which point messages were exchanged between England and France "under the strait and through it for the first time." The line consisted of a single gutta-percha covered wire 1/10 in. diameter coiled on a drum mounted amidships on the vessel, and weighing five tons. It was paid over a roller at the stern, and sunk to the bottom of the sea by means of leaden clamps. Within three days from being laid the line was destroyed, but the possibility of submarine telegraphy

was established, and a more ambitious and successful attempt was made in the following year. The cable here consisted of gutta-percha covered wires protected by coated hemp yarn, and an outside covering of galvanised iron wire. The weight of this cable was about 200 tons, and the electrical testing was carried out by Mr. Wollaston. This work took place on October 31, 1851, and on November 13 of the following year the cable was opened for public use between England and France.

WE regret to announce the death, on December 3, at forty-seven years of age, of Dr. A. Vaughan, lecturer on geology in the University of Oxford.

THE death is announced at Ranchi, India, of Colonel F. J. Drury, of the Indian Medical Service, Bengal. He was Inspector-General of the Civil Hospitals of Bihar and Orissa, and formerly professor of pathology at the Medical College, Calcutta.

THE death has occurred, in his sixty-eighth year, of Dr. M. A. Veeder, of Lyons, N.Y., who wrote largely on water supply and other questions relating to public health. He also made a study of the relation of pack ice in the great lakes of North America to the Glacial period, and carried out an extensive investigation of electromagnetic phenomena of solar origin, especially with reference to the causation of the aurora.

DR. GEORGE STERNBERG died on November 3, in his seventy-eighth year. He graduated at the College of Physicians and Surgeons, Columbia University, in 1860, entered the United States Army as assistant-surgeon in 1861, and retired with the rank of Brigadier-General in 1902. He served throughout the Civil War, and was in charge of the American Medical Service in the war with Spain in 1898. Dr. Sternberg had a special knowledge of cholera and yellow fever, and the Yellow Fever Commission of 1900 was appointed on his initiative, and practically solved the mode of transference by the mosquito. He founded the U.S. Army Medical School at Washington, and was the author of two large manuals of bacteriology, a treatise on malaria, a book on photomicrography, and a work on immunity, serum therapy, and protective inoculation, as well as many Government reports.

MR. GEORGE SMITH, who died on November 19, at the age of sixty-four, was one of the oldest and most experienced chemists and works managers in the employ of Nobel's Explosives Company, Limited, Glasgow. Born at Woolwich, he went through the School of Mines, and after some experience at the Woolwich Arsenal Laboratory, and at the Stowmarket Works of the New Explosives Company, he entered the services of Nobel's Explosives Company in 1879, as the works manager of their Westquarter Factory in Stirlingshire, where detonators and sulphuric acid were produced. During his capable management the factory grew in size and importance, other manufactures were added, and when Westquarter was no longer able to satisfy the demands placed on it a new factory was built at Linlithgow for powder fuse. Mr. Smith retired from active work in 1913, and lived afterwards at Hastings and St. Leonards. He was a fellow of the Royal Society of Edinburgh and of the Institute of Chemistry, and took out various patents during his active life. His numerous friends will long remember him and mourn his loss.

THE following are among the lecture arrangements at the Royal Institution before Easter:—Prof. H. H. Turner, a course of six illustrated lectures, adapted to a juvenile auditory, on "Wireless Messages from the Stars"; Prof. C. S. Sherrington, six lectures on the physiology of anger and fear, and nerve tone and posture; Dr. E. J. Russell, two lectures on the plant and the soil; Prof. A. Keith, two lectures on sea power as a factor in the evolution of modern races; Prof. F. Keeble, three lectures on modern horticulture; Prof. W. A. Bone, three lectures on utilisation of energy from coal; Sir F. Watson Dyson, Astronomer Royal, on measurement of the brightness of stars; Prof. L. W. King, two lectures on recent excavations in Mesopotamia; Prof. H. E. Armstrong, two lectures on organic chemistry in war; Sir J. J. Thomson, six lectures on radiation from atoms and electrons. The Friday evening meetings will commence on January 21, when Sir James Dewar will deliver a discourse on problems in capillarity. Succeeding discourses will be given by Prof. L. Hill, Prof. W. Bateson, Prof. E. G. Coker, Prof. S. P. Thompson, Sir Napier Shaw, Dr. A. Strahan, Prof. W. M. Bayliss, Prof. A. Fowler, and Sir J. J. Thomson.

THE theory that the possession of territory, and the struggle which this involves, was a factor in sexual selection was first definitely formulated by Mr. H. Eliot Howard, in his remarkable book on "The British Warblers." The soundness of this view is now attested by Mr. J. M. Dewar in his studies on the oyster-catcher in relation to its natural environment. In the *Zoologist* for November he goes still further, and holds that the "law should be extended to apply to the birds in winter, as they then have territories, though no opportunity has come under notice of a territory needing to be defended against intruders." Howard's view that the possession of territories is a biological advantage, both to the individual and to the species, by securing an adequate, and no more than an adequate, supply of food, is borne out by the general evidence derived from the areas under observation in regard to the oyster-catcher.

IN an article entitled "Reactions to the Cessation of Stimuli" (*Psychological Review*, vol. xxii., No. 6), Mr. H. Woodrow describes some experiments which show that the reaction to the cessation of a sound or light stimulus is in all cases the same as the reaction time to the beginning of that stimulus, and that the lengthening in reaction time due to a decrease in intensity of stimulus is equal in amount, and follows the same law, in the case of both beginning and cessation reactions. The author, in attempting to find an adequate hypothesis which shall subsume these facts, criticises both the latent period view and synaptic resistance, and develops his theory of the central nervous system as the seat of a complex system of inter-related activities and potential energies, which is disturbed throughout by any change in any part of the system. The physiological disturbance in this case is in part the process of becoming aware of a stimulus

or of attending to it. A small change in excitation disturbs the pre-existing cortical system so as to bring about the reaction time more slowly than does a large one, not because of the resistance to its conduction, but because of the inertia of the pre-existing central system. Physiologists and psychologists will find the article interesting and controversial.

IN the *Philippine Journal of Science*, vol. x., No. 5, for September, 1915, Mr. E. D. Merrill continues his descriptions of new or noteworthy plants from the Philippines. This instalment, which is No. xii. of the series, includes seven genera credited for the first time to the Archipelago, viz., Avena, Polytoca, Angelesia, Glyptopetalum, Ochrocarpus, Asystasia, and Polytrema. Sixty-two new species are described belonging to various families, and in all eighty species are added to the Philippine flora. The Avena is, no doubt, an introduced plant.

THE cultivation of sisal hemp and its preparation forms the subject of an article in the Bulletin of the Imperial Institute, vol. xiii., No. 3. From Mexico, the home of the plant, it has been widely distributed, and is now being successfully grown in British East Africa and in the Bahamas has long been introduced. The article deals especially with the history of the introduction of the plant into various countries and the preparation of the fibre for market, where its chief use is in the making of twine. It is pointed out that for a successful enterprise large areas must be planted, especially if a factory is to be erected. Details with figures are given of British machinery for the preparation of the fibre.

THE annual report of the Department of Agriculture, Uganda, for the year ending March 31, 1915, is a record of useful and steady progress. An interesting account of coffee cultivation is given, from which it is seen that the coffee-leaf disease (*Hemileia vastatrix*) is on the wane, and does not appear to be seriously affecting the coffee plantations in the country. A chart is given showing the fluctuations in the amount of the disease compared with rainfall and humidity on the Government plantation, Kampala, but the outstanding feature of the chart is that the disease reaches its maximum during the months July to September. Other fungus parasites are dealt with in the report of the Botanist, but there does not appear to be any serious disease affecting the economic products in Uganda.

THE ninety-third Report of the Commissioners of Woods, Forests, and Land Revenues, dated June 29, is mainly concerned with the financial state for the year of the Crown properties under their charge. These are multifarious in kind, including, in addition to land let for buildings, foreshores, mineral rights, etc., 346,935 acres, of which 69,103 acres are under the growth of timber. The main centre of active forestry operations is the Dean Forest and Highmeadow Woods in Gloucestershire, which are about to be used as a forestry demonstration area. The old school for the training of woodmen at Parkend has been extended to include more men under instruction; and a new School for Forest Students is now being erected near Speech House. The wood distillation works, which were opened in October, 1913, have proved successful. Large quantities of charcoal and fuel-wood from the various Crown forests were dispatched to the trenches in Flanders. Increased quantities of pit-wood have been sold from Dean Forest and Tintern Woods. The Crown holds in England 73,375 acres of agricultural estates, consisting mainly of farms varying from 50 to 1000 acres in extent; but 9,374 acres are now let for small holdings and allotments. The greater part of the latter have been created in the past nine years, during which period eighty-seven new cottages and seventy new sets of farm buildings were erected, whilst existing cottages and homesteads were altered and improved.

ACCORDING to the Bulletin of Economic and Social Intelligence issued by the International Institute of Agriculture, the co-operative movement is very successful in Finland, where 10 per cent. of the whole population are members of such societies; this proportion, in fact, is only surpassed by Denmark, where the corresponding figure is 25 per cent. An unusual organisation of the kind is that established for the working of peat moors. The use of peat litter in retaining the most valuable constituents of manure is generally recognised, and since Finland is very rich in peat deposits, their working in the interests of agriculture has developed greatly. The co-operative society buys a moor, or acquires the right of extracting peat, constructs the necessary drying sheds, and then sells the peat to its members. Some of these societies are very large, owning plant to the value of 4000*l.*, and exporting their peat abroad.

A THIRD article on the economic resources of the German colonies, dealing this time with those in West Africa, is published in the new number of the Bulletin of the Imperial Institute. The Cameroons, the chief peak of which rises to 13,000 feet, export rubber, palm kernels, cacao, and palm oil especially, and also to a smaller extent gum arabic, kola, and shea nuts. Some attention has been devoted to the cultivation of tobacco with considerable prospects of success. Stock-breeding, as in other German colonies, has been well developed, despite the difficulties caused by tsetse fly. Much of the territory is unexplored, but so far no minerals of particular economic importance are known. It may be added that so far as the flora is concerned, the region is remarkably interesting. Togoland exports oil palm products, maize, rubber, and cacao, and cotton, copra, ground nuts, and kapok are among the minor articles of export. A good deal of attention has also been paid to forestry, with promising results. Iron ores occur abundantly, and good limestone is also found, but lack of transport facilities has prevented the establishment of any definite iron-ore industry.

THE recently received second number of the fifth volume of the *Journal of Agricultural Research*, published by the Department of Agriculture in Washington, contains two interesting phytopathological papers by Mr. I. E. Melhus. In the first of these it is pointed out that the possession of perennial mycelium, hibernating in the tissues of their respective host-plants, is a characteristic feature of many species of

parasitic fungi belonging to the family Peronosporaceæ, of which perhaps the most widely known is the potato-blight fungus, *Phytophthora infestans*. A list of fifteen species is given in which this hibernation occurs, the necessary evidence being supplied by the author himself for four of them. In the second paper evidence is adduced to show that the source from which the potato-blight originates each season is to be found in aerial shoots of the potato, which become infected with the mycelium of the fungus direct from the diseased tuber. From nearly a thousand diseased tubers specially planted during the seasons of 1913 and 1914 five cases arose where one or more diseased, spore-bearing shoots were produced, and four of them served as centres from which the blight spread to neighbouring, healthy plants. That this might occur was shown by de Bary over half a century ago, but, although confirmed later by Jensen, it cannot be said that this view of the mode of infection of the crop has met with universal acceptance. Mr. Melhus's work, therefore—carried out under field conditions—provides a further and substantial measure of support for the original view propounded by de Bary.

IN the annual report of the Smithsonian Institution for 1914, Mr. E. N. Marais has an account of the drought in Watersberg, South Africa. The name was originally given as expressive of the fertility of that part of the Transvaal. To-day it is practically a desert with dried-up watercourses, dead orange groves, and desolate pasture lands. The game, once very plentiful, has almost all left the district, and little animal life remains. Only the numerous thermal springs remain unaffected, and on these the few inhabitants depend for drinking water and for irrigation.

THE pastoral and agricultural possibilities of Central Australia have been a good deal discussed in recent years. Attention was directed to them at last year's Australian meeting of the British Association. The probable value of the region to the north-east of Kalgoorlie and Laverton is indicated in a paper by Mr. A. C. Macdonald in the *Victorian Geographical Journal* (vol. xxxi., part ii.). Mr. Macdonald brings together evidence from explorers and others to show that the rainfall, though most irregular, is by no means absent, but that the soil would be most productive under a proper system of irrigation. This, he contends, would be feasible, since artesian water in quantities has been proved to exist near the surface. There is every indication that this water is quite suitable for irrigation, and is not heavily charged with alkali.

THE United States Geological Survey is publishing a series of four geographical handbooks for travellers, each book covering one of the chief railway routes west of the Mississippi. The second one deals with the Union Pacific route from Omaha to San Francisco (Bulletin 612, The Overland Route, price 1 dollar). The idea is excellent, and is admirably carried out. Much geographical information otherwise difficult of access is collected, and many historical details are added. The illustrations are good, but the chief feature of the volume is the series of twenty-five contour maps on a scale of 1 to 500,000. They are clear and well printed, and free from crowding of detail, yet contain all that a traveller could desire. Each map is conveniently placed for reference from the text. The book has much value even for those who do not contemplate going the journey.

THE Canadian Department of Mines has issued a very interesting monograph (Memoir No. 78) on the Wabana iron ore of Newfoundland, by Mr. A. O. Hayes. These famous iron-ore deposits form a number of beds, which outcrop for about three miles along the northern shore of Bell Island, Conception Bay, and dip to the north-west under the waters of the bay. These beds form part of an extensive series of Ordovician sedimentary deposits, mainly of sandstones and shales, comprising the higher beds of the northern limb of a somewhat flat anticline. The upper 1000 ft. of this series contain a number of ferriferous beds, two of which, known as the "Dominion Bed" and the "Scotia Bed," are of workable thickness, the former averaging about 10 ft. and the latter, the upper one, about 8 ft., though thicknesses up to 30 ft. have been met with. The total quantity of iron ore is estimated at more than 3000 millions of tons. The ores consist mainly of red hæmatite, together with chamosite (aluminous ferrous silicate), and siderite. The ore is oolitic in structure, the spherules consisting generally of alternate concentric layers of the two first-named minerals, though some consist wholly of hæmatite. Fragments of fossil shells occur throughout the ore, and it is to their presence that the phosphoric acid in the ore (usually 1·5 to 2·5 per cent.) is due. The author considers these ores to be primary deposits formed in shallow seas, and holds that "the iron was derived by long-continued weathering of earlier crystalline and sedimentary rocks, the solution of their iron content by mineral and vegetable acids and subsequent transportation of the iron salts by streams into the sea." He holds that the evidence is against the probability of these ores having been formed by the metasomasis of an original oolitic limestone.

THE rainfall over the British Isles for October is dealt with in *Symons's Meteorological Magazine* for November, and the rainfall table gives the tentative results of the British Rainfall Organisation prior to the publication of fuller details in the rainfall volume for 1915. There were only three stations in Great Britain with an excess of rain—Rousdon having 190 per cent. of the average, Stroud 121 per cent., and Braemar 103 per cent. Arncliffe, in Yorkshire, had only 21 per cent. of the average rainfall, and was relatively the driest place in the kingdom; Seathwaite had 26 per cent. of the average, and Hull 31 per cent., whilst other places had more than 33 per cent. The greater part of Ireland was wet, but the fall at Omagh was only 82 per cent. of the average, while it was as high as 179 per cent. at Waterford, and 155 per cent. at Gorey, Wexford. Less than one-half of the average rainfall for the month is said to have fallen over the west and north-west of Scotland and over the northern half of England and Wales. The map for the Thames Valley shows a considerable range in the rainfall, the measurement for the month amount-

ing to 7 in. in the south-west, whilst it was less than 2 in. in the north-east and in part of the upper Thames.

IN an address to the American Institute of Electrical Engineers in February last Dr. Rosa, chief physicist at the Bureau of Standards, gave an account of the work done by the bureau, with special reference to the electrical part of the work. The address is reproduced in the November number of the Journal of the Franklin Institute, and from it we learn that a new electrical building, 190 ft. by 60 ft., and five stories high, has just been completed at a cost of 40,000*l.*, and that a similar building is about to be erected for the chemical division. When this is complete the United States Government will have spent 400,000*l.* on the bureau and its equipment. So far as the electrical division is concerned, the work is subdivided into eleven sections as follows:—Resistance and electromotive force; inductance and capacity; commercial measuring instruments; magnetic measurements; photometry; wireless telegraphy; electric railway work; electric lighting and power; safety rules, regulations, and devices; gas supply; telephone service.

MR. C. P. SPARKS, who has succeeded Sir John Snell as president of the Institution of Electrical Engineers, delivered his inaugural address on November 18. He dealt chiefly with the development of the electricity supply industry, and, in the last part of his address, suggested the directions in which further progress might be anticipated. These, he thought, would largely be governed by the necessity for fuel economy, and he put forward the proposition that the economical use of coal had been hindered in this country by its low price. One of the next steps to lower the cost of production will be the gas-firing of boilers, the gas being obtained from producers worked at low temperature so as to provide by-products from the distillation of coal as a raw material for other industries. As the by-product processes can only be worked with real success on a large scale, this will have to be preceded by a fairly thorough centralisation of electricity supply stations, so that the outputs of the numerous small electricity works will gradually be merged into a few large generating stations of sufficient size to work with the utmost economy. The necessity for fuel economy will also result in the more complete displacement of gas lighting by electric lighting. With electricity generated in modern power-houses, and ordinary metal filament lamps, 750,000 candle-power-hours are generated per ton of coal, compared with 260,000 c.p. per ton of coal when gas and modern gas mantles are used. The extended use of so-called "half-watt" lamps will soon double this 750,000, so that it would require an improvement in gas mantles quite beyond the range of immediate probabilities to equalise matters.

SCIENTIFIC societies and journals which deal with certain special subjects do not appear to have suffered much by the war. This does not mean that those engaged in scientific work have held back from taking their places with the fighting forces; indeed, the rolls of honour of the universities show that exactly the reverse is the case. It may be due partly to the fact that many workers in science are past the military age, and partly also to the diminished number of students, leaving more time for research to those most qualified to carry it out. In certain directions there is even an expansion noticeable in the scope of the subjects dealt with, and we congratulate the editors of the *Archives of the Röntgen Ray* upon their choice of a new and wider title for that important publication. It is the only English periodical dealing with the subject of X-rays in all its bearings, and it naturally embraces radio-activity, in addition to matters concerning the applications of radiations generally as well as electricity to medical purposes. We note that the new title is *Archives of Radiology and Electrotherapy*, so that as broad a field as possible may be covered; and to judge by the issues since this change was made last June there is every reason to expect that this publication will meet with the success it deserves. To the publisher, Mr. W. Heinemann, great credit is due, especially for the excellence of the reproductions of radiographs. Each part is well and fully illustrated, and contains a valuable collection of data relating to cases of some special interest.

Engineering for December 3 contains the concluding article of a descriptive account of the machinery of the motor-ship *Kangaroo*, constructed by Messrs. Burmeister and Wain, Glasgow, and purchased by the Western Australian Government for carrying produce to Britain. The vessel is propelled by twin-screws, each driven by independent six-cylinder Diesel engines on the four-stroke cycle. Each cylinder has a diameter of 22·05 in., the stroke being 29·92 in.; the designed power for each set at 140 revs. per min. is 1125 indicated horse-power, making a total of 2250 indicated horse-power. Much care has been given in this ship to the general arrangement of the main engines and auxiliaries, and the whole design is noteworthy from this point of view. During the trials, at light draught, the full power was developed at 144 revs. per min., and the total consumption of oil-fuel for main and auxiliary engines was then 0·292 lb. per indicated horse-power per hour—a very creditable performance. The speed of the ship at light draught was 11·2 knots. Sir John H. Biles and Co. acted as naval architects for the owners.

M. MAX A. LAUBEUF, late chief constructor in the French Navy, read a paper on submarines at the International Engineering Congress, 1915, in San Francisco, a summary of which appears in *Engineering* for December 3. The present tendencies of the constitution of submarine flotillas appear to be (*a*) coastguard submarines of 350 to 500 tons surface displacement, well armed (*e.g.* two minor torpedo tubes and outer tubes or outer torpedo launching equipment), and having speeds of 14 to 16 knots on the surface, and 9 to 10 knots when submerged; (*b*) squadron submarines having a great displacement (say 1200 tons when submerged), high speed, say 23 knots surface speed and 15 knots submerged, and a powerful armament, say eight inner torpedo tubes and sixteen torpedoes on board. *Engineering* also reprints a paper on the submarine of to-morrow by Mr. L. Y. Spear, read at the Society of Naval Architects and

Marine Engineers in New York. Whatever may be the decision of the U.S.A. authorities as to the surface speed necessary, the author of this paper is firmly convinced of the relatively greater importance of the submerged qualities for this type of boat, and believes that battery capacity and submerged radius of action and speed should not be unduly sacrificed either in the interests of durability or first cost.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—According to a telegram received on December 5 from Prof. Strömgren, Copenhagen, a message from the Cape to the Astronomer Royal announces that a new comet was observed by Taylor on December 2 in a position "three minutes preceding sixteen minutes south of δ Orionis." It is stated to be moving slowly north, but no indication is given of its magnitude.

THE SOLAR ROTATION.—The detailed account of a valuable spectrographic determination of the latitude variation in velocity of the sun's rotation is presented by Mr. J. B. Hubrecht in a memoir forming part i. of vol. iii. of the Annals of the Solar Physics Observatory, Cambridge (see also Monthly Notices, R.A.S., No. 8). Four series of spectrograms were secured during the first fortnight of June, 1911, with the McClean solar instruments. Each series contained the material—forty-eight plates—from which velocity differences have been derived for pairs of plates taken in positions separated by 90° at intervals of 15° around the sun's limb. The region studied was λ 4300–λ 4400, under a dispersion in fourth order such that 1 A.U. = 1·13 mm. Attention may be directed to a point regarding the manipulation of the Zeiss comparator; the settings were made by simply pushing the slide, and the readings were taken to 0·0001 mm., with an average probable error per displacement of only 0·0004 mm.

The results obtained indicate that the velocities probably vary regularly according to wave-length, diminishing towards the red, due to some physical cause residing in the sun itself. The distribution of the velocities appears to be consistent with the requirements of Emden's theory of the constitution of the sun.

GALACTIC CO-ORDINATES.—The progress made of recent years in stellar astronomy has directed increasing attention to the employment of a natural system of co-ordinates in place of those based on the arbitrary, ever-changing geo-solar planes of reference. The fundamental plane of reference is obviously determined by the Milky Way, but there remains to be fixed the point of departure in longitude. Unfortunately, from analogy with the standard system choice of this initial point has fallen on the ascending node of the galaxy. Mr. R. T. A. Innes, in advocating the general introduction of secular co-ordinates, pointed out the great economy of effort they afford in connection with the study of the planetary motions, and proposes to fix the zero of galactic longitude by the apex of the sun's way, thus entirely eliminating the effect of precession. In Circular No. 29 of the Union Observatory, Mr. Innes supplies a convenient table for the conversion of equatorial into galactic co-ordinates. The table is calculated on the basis of Newcomb's position of the pole of the galaxy (α 191·1°, δ +26·8°, and Campbell's determination of the solar apex (α 270·0, δ +30·0°), and contains the galactic equivalents of every 5° of declination and twenty minutes of right ascension, also galactic parallactic angles for converting north pole position angles into corresponding position angles referred to the north galactic pole.

A MARTIAN CALENDAR.—In Report on Mars, No. 10, Prof. William H. Pickering gives what should prove a convenient calendar for the use of observers of the planet Mars. The Martian year is divided into 669 calendar days of 24h. 38m. 42·04s. each, the planet's sidereal day (*i.e.* time period of rotation) being 1m. 19·39s. shorter. Fifty-six days are allotted to the first nine "months," and one day less to each of the other three. The "week" of seven days is thus retained as a unit. The year commences at vernal equinox, Martian date, March 1 = terrestrial date, March 20. The same report also contains some remarks on the possibility of observing gemination of canals during the coming opposition, and concludes with a discussion of colouring of the markings.

THE CENTENARY OF THE SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES.

THE centenary of the Swiss Natural Science Society was celebrated on September 12–15. The meeting was a great success, and was marked by two touching ceremonies: the placing of a laurel crown before the monument of Henri Albert Gosse, the gifted apothecary of Geneva, who with Pastor Wyttenbach, of Berne, originated this great national society, and the inauguration of a monument to the Swiss naturalist Forel at Morges. Both these monuments consist of fine erratic blocks, with the head of the naturalist carved in the form of a medallion. One stands in the shady garden surrounding the University of Geneva; the other has been placed in one of the most exquisite spots on the banks of Lake Leman. But it is not in these grand stones that we must seek the record of the fame of those they commemorate. It is in the living society which has carried out the ideals and continued the work of its founders—a society of which Forel formed until three years ago a prominent member—that the glory of these simple lovers of Nature and of their country is to be found.

The primary idea in founding the society was patriotic; a secondary one, dependent on the success of the undertaking, was that the society would be visited by *savants* from all countries, and that it might prove itself a source of light the rays of which should spread over the whole scientific world. Both these ideas have been realised in the hundred years that have passed, but it is interesting that the centenary should fall at a moment when the former only could have any prominence.

There were no official delegates from foreign countries, and practically all the participators were Swiss. The author of the present account was the only member of the English scientific world at the meeting, but she and Prof. W. H. Young, whose absence in America alone prevented his giving personally the communication presented in his name, are accepted by the Genevese scientific circle as almost, if not quite, of them.

In these circumstances, and in view of certain superficial elements of discord between the French and German Swiss, which the war has brought under the eye of the public, the occasion was made one for a manifestation of patriotic feeling. The President of the Confederation was present, and gave a memorable and eloquent address to the society after the official banquet at the Parc des Eaux Vives, lately become the property of the town of Geneva. President Motta is a native of Italian Switzerland, a fact

of no small importance at the present crisis. Switzerland, one and indivisible, her children diverse in speech and modes of thought, only the more efficient for that diversity, were mirrored in that patriotic confraternity of science, inaugurated by a citizen of Romance Geneva and one of Allemannic Berne. Among the names, too, of the great Swiss naturalists, French and German as they sound, Swiss as they are—Agassiz, de Candolle, Vogt, Forel, Escher, Merian, Studer—whom President Motta cited as written in golden letters in the great book of European science, he placed one more, that of Luigi Lavizzari, not only as worthy of as high a place, but more especially for having devoted his life to the description of the natural beauties of that corner of earth which the president called "his own," which unites on a small surface, eternal snow and plains rich in corn, sombre pines and sweet olive-trees, the severe shadows of the north, and the brilliant lights of southern landscapes.

"How," the president exclaimed, "can one be Swiss without loving Nature? It is the sense of the infinite and the insatiable thirst for perfection and for truth which confer on man, with his royal littleness—the idea is Pascal's—his true greatness. How can one love Nature without loving Science, whose aim is disinterested research, and whose condition of existence is intellectual liberty? And how can we love Nature and Science without being attached to the soil of our country with all the fibres of our heart?

"Certainly the country is not only the soil on which the people dwell; it is more than that; it is composed of the patrimony of the past and the aspirations of the future; it is formed by the holiness of customs and the spirit of institutions; it is the physical and moral tradition which binds the dead to the living and the living to those that shall be born; but the soil remains an essential part of the country. And when this soil itself represents a little world, when it offers to its children the most touching and the most picturesque sights, grace and sublimity side by side, oh! then the soil is sacred. It becomes the source of the sanest thoughts and the purest emotions. It explains in some sort our history and why Switzerland cannot be other than a democracy, that is to say, a popular government aspiring always to more liberty, more justice, and more fraternity; to defend it, to defend this soil, each of us in the hour of danger would be ready, if need were, to sacrifice his blood and his life.

"No," he continued, "none of us will ever admit in our midst the struggles and the competition of races. The present hour, which has given birth in all the belligerent countries to proofs of self-sacrifice and devotion, arousing on our part cries of admiration and of pity, brings out that which is murky, sad, and almost inhuman in these struggles and antagonisms.

"Switzerland will remain for ever a fraternal republic. No one has ever demanded that the differences of race, language, and education should disappear. The ideal of a State like ours is not uniformity; we know that our State would lose a capital part of its force and its value if it ceased to exhibit that variety of tendencies, languages, and methods of education; but variety means emulation and not contrast. . . . To set the Latins against the Germans, as irreconcilable enemies, would be not only a bad deed, contrary to the moral and political constitution of the country, but also an attack on Christianity and civilisation."

In concluding, the president referred in moving words to the work of the Red Cross, and to its founder, the Swiss Henri Dunant. "What more appropriate wish," he cried, "can I formulate for the Swiss Natural History Society than that it should, in the second century of its existence, become the Red Cross of Science, to bind up and to heal the most distressing of ulcers and the most mortal of wounds, those which torment souls and part spirits?"

In spite of the war, which in Switzerland, as elsewhere, has affected scientific productivity, a valuable series of communications was presented to the society. The programme was as follows:—

(1) *Mathematics.*—L. G. Du Pasquier, On systems of complex numbers; G. Polya, Is a series of powers in general capable of analytic continuation?; M. Plancherel, On the convergence of a remarkable class of definite integrals, involving an arbitrary function; W. H. Young, On integration with respect to a function of bounded variation; G. Chisholm Young, On curves without tangents; D. Mirimanoff, On the tile theorem; L. Crelier, On a theorem in kinematic geometry; R. de Saussure, The geometry of *feuillets côtés*; G. Cailler, Analytical discussion of the same. (A *feuillet côté* is a geometrical form consisting of a point, a straight line through it, and a plane through that, all being weighted, or "côté," with an additional number. The theory has much analogy with the theory of screws, but has two more degrees of freedom.) H. Berliner, A new analytic geometry; Gonseth, Two generalisations of a theorem of Poncelet.

(2) *Physics.*—L. de la Rive, On the movement of the ether relative to the earth; A. Hagenbach and W. Rickenbacher, Comparison of the thickness of soap films when measured optically and electrically; E. Guillaume, On Maxwell's law of repartition; C. E. Guye and C. Levanchy, Experimental verification of the formula of Lorentz-Einstein for cathodic rays of high velocity; A. Schidlof, Recent researches into the charge of the electron and Avogadro's number; A. Tcherniawsky and Z. Popoff, The flow of mercury along tinned wires; S. Ratnowsky, The constants of entropy for gases and the theory of rigid bodies; A. Piccard and A. Cherbuliez, A new method of studying paramagnetic salts in very dilute solution; J. de Kowalski, On the radiation of an oscillating electric spark; A. Gockel, On rays which pierce through the atmosphere; J. Andrade, An exact balance for the measurement of horizontal force.

(3) *Geology and Geophysics.*—A. Brun, The action of steam on eruptive rocks at a high temperature; L. Rollier, On the Mesozoic palæography of Switzerland; M. Lugeon, Some new facts in the geology of the Dent de Morcles; R. Billwiller, The chief types of great deposits in Switzerland; A. de Quervain, Report of the Commission of glaciers in Zurich (1915), and the work done in the seismological department of the Swiss Meteorological Institute; J. Maurer, On the repetition of the sun-spot periods in the observations of the Northern Lights made in Switzerland since 1540; A. Heim, On the relation of variations of gravity to the geological structure of Switzerland; P. Girardin, The changes of the limit of perpetual snow in Savoy and the Alps in historic times; L. Collet, The subterranean outlet of the Seewlisee (Uri); A. Buxtorf, The geology of the Grenchenberg Tunnel; B. G. Escher, Stones with furrows and rills.

(4) *Chemistry.*—E. Noelting and F. Steimle, The preparation of compounds with closed chains; E. Noelting and E. Kempf, On the properties of trianisylcarbinol for dyeing; L. Reutter, A contribution to the chemistry of the physiological powder of juniper; A. Werner, On compounds containing at the same time asymmetric carbon atoms and an asymmetric cobalt atom; F. Fichter, Electrochemical re-

duction and oxidisation of organic compounds of arsenic; S. Reich, Nitration of phenylpropiolic acid; P. Dutoit, On the mechanism of the formation of certain precipitates; E. Briner, On the formation and the decomposition of the metallic carbures; O. Kaiser, On the hydrocarbons in coal; M. Duboux, On a differential calorimeter; G. de Montmollin and O. Billeter, The action of cyanide of benzine-sulphonyle on sulphuretted compounds; A. Pictet and T. Q. Chou, Direct formation of alkaloids starting with albumines; L. Pelet, On the theory of dyeing.

(5) *Botany.*—A. Ernst, Researches into *Chara crinata*; C. Schroter, Recent researches in botanic geography in North America; P. Jaccard, On the distribution of medullar rays in the conifers; B. P. G. Hochreutiner, On certain new species of Malvaceæ; G. Senn, The distribution of chromotophores in marine algæ; E. Kelhofer, Wooded and cultivated parts of the Jura near Schaffhausen; M. Rikli, The flora of Crete; A. Trondle, On the permeability of the tip of the root; M. Jäggli, The delta of the Maggia and its vegetation; J. Briquet, The vegetable parts of the Cruciferæ sempervivoides.

(6) *Zoology.*—Dr. Thomas, A critical study of mountain sickness; P. Revilliod, Preliminary note on the osteology of the fossil Chiropteræ in Tertiary beds; J. Roux, The family of the Atyidæ; E. A. Göldi, Comparative development in the sexual reproduction of plants and animals; A. Oswald, On the action of the glands of internal secretion on the circulation; A. Burdet, The birds of the island of Texel, Holland; O. E. Imhof, The molluscs of our Alpine lakes; H. Blanc, Contribution to the anatomy of *Chlamydophorus truncatus*; L. Ascher, (*a*) The factors determining the internal secretion of the glandula suprarenales, (*b*) the innervation of the liver; (*c*) the acoustic properties of the canales semi-circulares; A. Lipschütz, The importance of physiology in the study of development; E. Yung, The effects of inanition on the cell; A. Gandolfi, Observations on the distribution of *Daphnia hyalina* in the Lake Leman; E. André, The balantidium of the amphibians.

(7) *Entomology.*—C. Emery, History of an experimental society of amazon ants; J. L. Reverdin, Revision of the palæoarctic species Hesperia; E. A. Göldi, New discoveries in the origin of sex, the determination of sex, and the proportion of the sexes in insect states, particularly in the cases of the honey-bee and the neotropic ants; F. Ris, Census of the Swiss Plecoptera by F. J. Pictet in 1841 and nowadays; O. Schneider-Orelli, On the biology of *Phylloxera vastatrix*; F. Brocher, The circulation of the blood in the wings of the Dyticidæ; C. Ferrière, The utilisation of insects which eat other insects; H. Faes, On the value of the powder of pyrethra obtained from indigenous plants for insecticide purposes; A. Pictet, Hereditary and individual reactions in insects.

(8) *Anthropology and Ethnography.*—Dr. Lardy, The grotto of Cotanchere; H. Lagotala, Study of a hundred Genevese femurs; Dr. Montandon, The instruments of music in the ethnographic museum at Geneva; R. Montandon, The handling of stones at the Moustierian station of Rebières; Prof. Schlaginhaufen, The Neolithic lake-dwellings of Egolzwil; E. Matthias, The influence of physical exercise on growth; A. Schultz, New projective measurements of the skull; H. Hoessly, Craniological investigations among the east Eskimos, after the Greenland expedition of 1912; A. Cartier, The chief discoveries at the Magdalenian station of Veyrier; E. Pittard, Castration and the morphological modifications which it causes in man.

On September 13 and 15 lectures were given to the assembled society in the Aula of the University. Prof. Emile Yung, the eminent Genevan zoologist, gave an interesting account of the first century of the society, and laid before the meeting the *Livre du centenaire*. The venerable geologist, Prof. Albert Heim, the friend of Forel, spoke on fresh light in the investigation of the Jura Mountains; Prof. P. L. Mercanton, of Lausanne, reported on forty years' mensuration of the Rhone glacier; Dr. Fritz Sarasin, of Basel, the well-known traveller and archæologist, gave a lecture, with lantern-slides, on an archipelago in the Pacific Ocean—the Loyalty Isles; and Dr. E. Rübel, of Zürich, spoke of the international botano-geographic expedition to North America, also with magic lantern. But the most remarkable was the opening discourse of the president, Prof. Amé Pictet, of Geneva. It dealt with molecular structure and its influence on life and death. What, he asks, is it that renders matter living? And, again, what is it that renders some matter injurious and some harmless or beneficial? To study these profound questions, Prof. Pictet turns to the vegetable world, as more fundamental in the scale of life than the more dependent animal realm. It is the plants, indeed, that are able to perform the synthesis of organic substances on which all life seems to depend. In the vegetable world it is the group of poisons known as the alkaloids which have yielded up their secret to Prof. Pictet's patient study. His theory is that it is to the molecular constitution that we must look. It has been shown that all the organic compounds known belong to two types of molecular structure: (1) open chains, and (2) closed chains. These two classes of compounds are separated by a great gulf; but it is not impassable. The passage from the open to the closed chain can be effected with comparative ease by means of chemical reactions, but the reverse process is difficult. The closed chain is a very stable molecular form, and this it is which Prof. Pictet connects with death. Life is, roughly speaking, the passage of all open chains to the closed form. Such closed chains may be, and indeed must be, formed from time to time in the organism, and constitute the life in death, from which the animal tries to free itself by excretion. The plant cannot do this, but it protects itself internally from these dangerous products. Such are the essential oils, turpentines, and camphors, which constitute so many of our perfumes; such, again, are the caoutchoucs and tannins, the vegetable colouring matters, and the deadly poisons hidden in various plants. These, Prof. Pictet tells us, are products of denutrition; they are like our so-much-talked-of uric acid. We find them, not in the living cell, but packed away in dead cells, and often wrapped round with protecting covers to prevent them from harming the living plant. Thus, he concluded, the serpent who bites his own tail, which was the symbol of eternity with the ancients, deserves to become for the modern biochemist the symbol of death.

GRACE CHISHOLM YOUNG.

THE CONCH SHELL OF INDIA.[1]

THE conch or chank shell (*Turbinella pyrum*) is so intimately connected with the religious and social life of the people of India that the monograph on the subject prepared by Mr. J. Hornell, Superintendent of Pearl and Chank Fisheries to the Government of Madras, is welcome. He has gained in the course of his official duties a knowledge of the industry in Madras, and he was recently deputed by

1 Madras Fisheries Bureau. Bulletin No. 7. "The Sacred Chank of India: A Monograph of the Indian Conch (*Turbinella pyrum*)." By J. Hornell. Pp. viii+181+18 plates. (Madras: Government Press, 1914.) Price 3s.

the Government of that province to investigate its conditions in other parts of the country.

Among the five areas in which the shells are collected—Tinnevelly, usually known as the Tuticorin fishery, Ramnad, the Carnatic Coast, Travancore, and Kathiawar—the first is the only place where it is carried on systematically, and it has existed here for at least 1800 years. Early evidence of the use of the shell is found in the Foote collection of Indian prehistoric antiquities in the Madras Government Museum, and more recent excavations, conducted by Mr. A. Rea, have furnished additional examples. In Mysore the specimens have been supposed to date back to Neolithic times, but as the shells cannot be worked without a metal saw, they probably belong to a later age, that of iron.

In Tinnevelly, where the industry is carried on under official superintendence, about seventy divers are employed. In favourable circumstances, a diver may in each excursion to the beds make twenty-five descents, each yielding from nothing to eight shells. These on reaching the shore are classified in nine grades, ranging from 4 to 2¼ inches in diameter; the wormed shells, being of inferior value, are placed in a special category.

The chief economical value of the shell is for the production of bangles or bracelets, the object of wearing them being partly for purposes of ornament, partly as a protective against evil spirits and the evil eye. While the source of supply is mainly southern India, the manufacture of bangles is now practically confined to Bengal. Mr. Hornell suggests that this transference of the manufacture took place in the fourteenth century, which marks the downfall of Hindu supremacy in the south, when the rich cities of the Pandyan kingdom were sacked by the Mahomedans, and the coast trade passed into Arab hands. At the present day the shells are imported to Calcutta, and pass thence to Dacca and other centres in Bengal, where they are cut by the Sankhari caste, which holds a high place in the Hindu social system. The wearing of chank bangles is now virtually confined to Lower Bengal and the hill tribes north and east of the province, from the Santals to the tribes of Assam and Manipur, and from the Sunderbuns to the Himalayas and the Tibetan plateau. Some 2½ million shells appear to be worked up annually in Bengal. The columella is first extracted by sawing off a slice of the lip and smashing the apex. The sawyer sits on an earthen floor tightly wedged between two short wooden stakes driven into the ground, one supporting his back and his toes against the other. He presses with one foot a disc of hard wood against the mouth aperture and divides the shell into sections with a heavy saw, the blade of which is in the form of a crescent ending in a hook at each end. The use of any more elaborate machinery is unknown. He is paid about one rupee for every ten shells he cuts. The work is very fatiguing, owing to the constrained position of the artificer.

Besides being cut into bangles, the shell supplies other forms of ornament, rings, necklaces, coat or dress buttons being made from it. Up to quite recent times these shells were used as currency in the Naga Hills. Some of the fragments are burned into a fine lime, used for industrial purposes and as a cure for various diseases, such as rickets, asthma, and cough. This is justified by modern medical research, the lime being useful to strengthen the bones of rickety children or by the deposit of salts round tuberculous centres. A minor use of the shell is to supply the equivalent of our infants' feeding-bottles.

Besides these economical uses of the shell, it is employed in various ways connected with the religious and social life of the Hindus. It is the emblem of the god Vishnu, and when the convolutions take the sinistral or left-hand form it is highly valued, and deposited in temples of the god. The four daily services at a Hindu temple are announced by blowing the shell, which in ancient times was also used as a war trumpet. No one who has encamped near a Hindu temple will forget the weird muffled roar which calls the god to wake at early dawn and receive the service of his worshippers. Beggars blow the shell as an appeal for alms. It is specially valued as a protective against the evil eye, and hence water is poured from it on the foundation-stone of a temple or house, or it is hung round the necks of children or cattle. It is blown at harvest when a man undergoes a special purification and is sent to cut the first-fruits, and at marriages to scare the evil spirits which beset bride and bridegroom. With the same object it is sounded when a corpse is being carried to the funeral pyre or to the burial ground.

On the whole, this survey of one of the purely indigenous industries of the country, the products of which are all locally absorbed, is of sufficient interest to justify the labour which Mr. Hornell has undertaken in collecting the materials for his excellent monograph.

LUMINOUS INSECTS.[1]

THE power of emitting light at night is a property that has been developed to varying extent in many different branches of the animal kingdom. We find it, for instance, in the Protozoa, *e.g.* Noctiluca, an organism which, though microscopic in size, is sometimes present in such countless millions on the surface waters of the ocean as to make the whole sea appear to be ablaze with a pale, cold, "phosphorescent" light. Higher in the animal scale we find the property well developed in the Hydrozoa, *e.g.* Pyrosoma, a colonial oceanic form. We have it again in numerous molluscs, in the insects, and even in the vertebrates, a large number of the fish that inhabit the abysmal depths of ocean, where the sun's rays can never penetrate, carrying their own lamps disposed about their bodies in patterns that vary according to the species. Here, however, I propose to consider only the insects that exhibit this power.

There is, as might be expected considering the striking nature of the phenomena in question, a very extensive literature on the subject. This is for the most part scattered throughout numerous scientific periodicals, but the earliest part of it, up to 1887, has been collected together by Gadeau de Kerville in his "Insects Phosphorescents," published in that year.

It is rather remarkable that the beetles (Coleoptera) have almost a monopoly of light emission amongst insects, and even here the property is almost confined to two families. The first, and by far the most important of these, for our consideration, is the Lampyridæ, or, to give them their popular name, the glow-worms and fireflies. With them are associated one or two small closely allied families, the Phengodidæ, Rhagophthalmidæ, etc., some of which are as yet very imperfectly known and unsatisfactorily characterised. In the Lampyridæ proper the luminous organs, when present, are generally found in both sexes, though frequently more strongly developed in one than in the other, and are situated in the terminal or subterminal segments of the abdomen, the light being shown from the ventral surface.

All members of this society are familiar with the glow-worm of this country, *Lampyris noctiluca*. I

[1] From a paper read before the South London Entomological and Natural History Society by K. G. Blair.

will remind you that in this species, in the adult stage, the light-giving property is practically confined to the female. Destitute of wings, she is rather an unlovely object, doomed to crawl about amongst the grass and low herbage, while her prospective spouse enjoys the freedom of the air above her. Yet her light is emitted from the underside of her tail, a situation that would not at first sight appear to be particularly well chosen as a source of illumination. Her *modus operandi* in exhibiting her light is usually to climb a little way up some convenient stem and to sit there with her lamp suspended, her body twisted a little to one side so as to exhibit the light without obstruction. If she can find no stem stiff enough to bear her weight she will remain with her body on the ground, the abdomen twisted to one side to expose the light as freely as possible, turning it first to one side then to the other in her attempts to attract the attention of wandering males. At Lugano Mr. H. Main and I have observed that they were particularly partial to old walls, even sitting 10 or 12 ft. above the ground. Though we found the larvæ fairly plentiful in the grass the female beetles were always on the walls, and in such a situation their light was plainly visible from a long distance; the twisting motion of the abdomen was also clearly observed.

Luminous organs are present in the male glow-worm in a similar situation, but to a very minor degree. The extent to which they are functional possibly varies in different localities. It is probable that in this sex the light is emitted only for a comparatively short time after reaching maturity, and that it soon becomes exhausted.

Photogenic organs are also present in an advanced degree in both the larva and the pupa; even the eggs are luminous, though there is here no definite light organ, but the whole surface glows faintly.

To the same family belong the "fireflies" of southern Europe. Of these there is a considerable number of species, which possibly present slight differences in the details of their light emission. One of the best known is *Luciola italica* of northern Italy, a species the habits of which Mr. Main and I had the pleasure of studying at Lugano.

Luciola italica was observed on the evening of our arrival at Lugano, in the grounds of the school, near the lake. Though abundant after dark, they were scarcely to be observed during the day. The first flashes were seen about 8.30, while the lingering daylight was fairly strong, and they were most numerous about 9.30 or 10, after which time their numbers noticeably decreased, though they could still be seen from our bedroom windows well after 11 p.m.

As was to be expected, all the fireflies caught on the wing were males. They have a fairly steady, not very rapid, flight, and flash their light at almost regular intervals, but they do not obviously appear to be searching for the females. When they do perceive an answering flash—and the discovery seems to be a matter of accident rather than the result of deliberate search—they pause in their course, and then fly down to it, although they may be as much as 10 ft. away.

The females were never observed to use their wings, but were always found on the grass or the herbage. In these insects, unlike the American Photuris, etc., observed two years ago, the initiative in seeking a mate appears to be with the female, as in the case of Lampyris. At times they will be quite dark, while sometimes they will glow with an almost steady, though not very bright, light. When "calling" for a mate, however, they flash with rather long slow flashes, incompletely extinguished in the intervals. Such a period of flashing is usually of short duration, and is succeeded by a dark period. It is this succession of slow flashes that bears the appearance of definitely calling for a mate, and during which the males most readily approach her, though they are also attracted to some extent by a steady glow.

The males, both in captivity and in nature, *i.e.* when caught in a spider's web, were observed to glow with a constant though not very brilliant light, somewhat resembling the steady light of a female, but no case of flying males approaching these dead males was observed.

The mating habits of many American species of Lampyridæ, popularly known as lightning-bugs, have been investigated recently by McDermott.[2] In these insects, as in the European Luciola, both sexes are luminous, and the light is emitted as a series of coruscating flashes. Again, the male has the more brilliant light, but in these insects he seems to take the initiative in searching for a mate, hovering over the ground flashing his lamp, and apparently watching for an answering flash from the less active female concealed in the grass.

The lightning-bugs investigated by McDermott belong mainly to the genus Photinus, of which the species are numerous, two or more of them often being found on the same ground. The results of this investigator's observations, assisted by a series of ingenious experiments with small electric bulbs which could be operated to simulate the flash of the insect, conclusively show that each species has its characteristic method of exhibiting its light, and that an individual of any one species will in general only reply to, or evoke a reply from, a member of the opposite sex of that species. He found, however, that some species would respond much more readily to his artificial flashes than others, and that some would even answer the flash of a match.

A few details of his observations on certain species may perhaps be quoted:—

Photinus pyralis.—The flash of the female is given three or four seconds after that of the male, and is of the same colour, but of longer duration and less intense.

Females would answer in numbers to the flash of a match swung in an arc to simulate the flash of a male, though as a rule not more than one female would reply to a flashing male.

A particular female would not reply to the flash of a male of another species (*P. consanguineus*) though she would to that of a match.

The male could also be deceived by a bulb placed in the grass and flashed three to five seconds after his own flash; when the bulb was flashed without the pause it was not so effective.

No male was ever observed to reply to the flash of a creeping male.

P. consanguineus.—The male gives a double flash, two flashes in quick succession followed by a pause, then two more, and so on; the female replies within a second to the second flash of the male.

A particular female would not reply to the flash of a match, but would answer the double flash of a bulb when 20 or 30 ft. away; on a nearer approach she seemed to recognise something unusual and would no longer reply.

P. scintillans.—The male gives a short single flash and the female a longer single flash; the female in this species is apterous.

A female would reply to the first flash of a male of *P. consanguineus*, but the latter takes no notice.

P. marginellus.—The male gives a single short sharp

[2] *Canad. Entom.*, 1910, pp. 357-363; 1911, pp. 399-406; 1912, p. 73 and pp. 309-312.

flash, yellower than that of *P. scintillans*; the female replies with a double flash, the first sharper and brighter than the second, followed at once by the second. The reply is given very quickly after the flash of the male.

P. castus.—The male gives a single flash, not so short and sudden as that of *P. marginellus*; the female gives a single flash very much like that of *P. scintillans*, but delivered immediately after the flash of the male; there is no distinct pause as in *P. pyralis*, and no indication of doubling as in *P. marginellus*.

P. castus and *P. marginellus* are very similar, and, indeed, by some authorities, have been considered to be merely forms of one species. Mr. McDermott admits that he can find no points of structural difference between them, but considers them distinct species on account of the very different flashes emitted by them. They are frequently found flying together, but no case of interbreeding has been observed, though especially watched for.

Mr. E. E. Green[3] has published notes on the use of the light by certain species of luminous beetles in Ceylon. Of these, one, *Lamprophorus tenebrosus*, Walk., belongs to the Lampyridæ properly so called. The female of this species is apterous with a ventral subterminal light-organ which she exposes much in the manner of our glow-worm. The male, though normally brilliant, approaches a "calling" female with the light shut off, its advent being heralded only by the partial extinction of the light of the female.

The other species mentioned by Mr. Green present certain marked differences from normal Lampyridæ in the emission of their light as well as in structural points, and have been placed in a separate family, Rhagophthalmidæ. Concerning the light of *Dioptoma adamsi*, Pasc., Mr. Green notes the larviform female was observed to recurve the body over the back so as to expose the ventral subterminal light organ. On the approach of the male the light was partially eclipsed and the tail turned down. The male at the time was not known to be luminous, but under the stimulus of sexual excitement, it was observed to exhibit a row of luminous spots along each side of the abdomen, as well as dorsal spots on the abdomen and across the base of the thorax.

I have recently received from Mr. Gairdner, of Bangkok, some females of a glow-worm which, he reports, turn up their tails to exhibit the light in a similar way to Dioptoma. Like the female Dioptoma, too, they are of a more degenerative type than Lampyris females, the antennæ and legs being small and feeble with a reduced number of joints.

Allied to these and to the Lampyridæ is another small family, the Phengodidæ, many of the members of which possess very remarkable luminous properties. In Brazil and Argentina, for example, is an insect that on account of its peculiar scheme of luminosity has long been known as a "railway" larva. The head of this creature glows brightly with a red light, like a live coal, which is more or less intermittent in character, while along each side of the body is a row of more constant lights, green or yellow, or even changing at intervals from a bluish to a more yellow hue. For many years these "railway" larvæ were nothing more than a puzzle to entomologists. On account of their light-giving powers they were usually considered to be lampyrid larvæ, though nothing else like them was known. Still less were they like the larvæ of the only other known luminous coleopterus family, the Elateridæ. The astonishment was great when in 1885[4] it was announced that the botanist, Hieronymus, had found one of these so-called "larvæ" mated with a beetle belonging to the genus Phengodes. Eggs were obtained from it which in due course produced larvæ, thus proving that the supposed larva was in reality the sexually mature, though degenerate and completely larviform, female of a beetle.

We are now confronted with the very interesting question as to whether the apterous, more or less larviform, state of the females of many of these glow-worms is a primitive condition or the result of degeneration from an earlier, higher, winged type. Riley[5] states that the female larva of *Phengodes laticollis* and *Zarhipis riversii*, both North American species, goes through a pseudo-pupal state prior to the final moult. It appears, therefore, that this larviform female is a mature though degenerate female, and that we have not here to do with a case of pædogenesis; *i.e.* of the larva becoming sexually mature without the attainment of somatic and metamorphic maturity.

The same writer considered that we here "get a glimpse, so to speak, into the remote post, from which has been handed down to us, with but little alteration, an archetypal Hexapod form which prevailed before complete metamorphosis had originated." Were this really the case, it is difficult to account for the occurrence of a pupal state in the individual development of the female, though this might perhaps be interpreted as a partial transference from the metamorphosis of the male. Further, if the larviform condition is to be explained as a case of arrested development and the persistence of a primitive type, either one would expect to find it fairly constant in a group of closely related species, and genera evidently arising from a common ancestry, or it must be considered as a kind of throw-back or reversion to an ancestral type.

For my part I prefer to regard the theory of degradation from an earlier winged type as affording a better explanation of the facts as we find them. We have the successive stages in such degeneration all illustrated, from the fully winged though sluggish female of Luciola, through the brachypterous state found in the females of certain species of Photinus, down through the apterous but otherwise developmentally mature females of Lampyris, and the more degenerate type of female of Dioptoma to the completely larviform females of Phengodes. The steps in this series do not imply relationship or common ancestry, but merely indicate the points, successively further and further back in the phylogeny of the group, when the use of the wings in the course of any particular line of development was discarded and their consequent degeneration set in, or, to put it briefly, that the apterous condition is of polyphyletic origin. I know of no instance among the Lampyridæ, such as we have amongst the Lepidoptera with apterous females (*e.g. Anisopteryx aescularia*) where, though wings are wanting in the adult, there are well-developed wing rudiments in the pupa, but I have found one female of *Lampyris noctiluca* with the wing and wing-cover well developed, though shrivelled, on one side of the body.

With the question of the evolution of the apterous female is bound up the question of the evolution of the power of luminosity. Many members of the family Lampyridæ are probably not luminous at all. Pale yellowish abdominal spots are almost always to be detected in the region of the luminous organ, but whether the species possessing them are always luminous is open to doubt. Our knowledge of the habits of many of these insects is extremely defective, and it is frequently impossible to say from dried specimens whether a species is or is not luminous.

[3] Trans Ent. Soc., 1912, p. 717.

[4] Haase, *Sitzungs. Naturf. Ges. Isis.*, p. 10: and *Deutsche Ent. Zeit.*, xxxii., p. 114; "Camb. Nat. Hist. Ins.," part ii., p. 251.

[5] *Ent. Mo. Mag.*, xxiv., 1887, p. 148.

In most of the luminous species the eyes, particularly of the males, are extraordinarily large and well developed (*e.g.* Lampyris, Photinus, Luciola, etc.), but the antennæ are simple. In the non-luminous species, on the other hand, the eyes are of a more normal size, but the antennæ of the male are frequently strongly plumose (*e.g.* Cladodes, Lamprocera, etc.), a feature that in this order as in the Lepidoptera is usually regarded as indicative of a highly developed sense of sex-perception in this sex, correlated with the possession of sluggish and retiring habits on the part of the female. It is noteworthy that in the genus Phengodes both the plumose antennæ of the male and the powers of luminosity of the female are unusually well developed.

Undoubtedly the chief function of the light is in securing the mating of the sexes, but that this is a secondary function only is evidenced by the different degree to which the use of the light is developed. Its wide occurrence within the family proves that the power of emitting light must have arisen early in the evolution of the family, though exactly how it originated it is impossible to say. Possibly, it may have served at first as an indication of unpalatability, common to both sexes, and then, coming under the influence of sexual selection as an evolutionary force, have developed along the various lines we see indicated. In connection with their unpalatable qualities, it may be noted that the Lampyridæ is a family that has many mimics in other families of beetles, amongst the Telephoridæ, for example, and the longicorns. Species of the longicorn genera Amphionycha and Dadoychus even go so far as to have a ventral pseudo-luminous patch resembling the luminous patch of the fireflies, but in the allied genus Alampyris, where the dorsal mimicry is quite as close, this patch is lacking.

Apart from its principal function in securing the proper mating of the sexes, the light seems also to be largely used, at any rate by the males, for purposes of display. Where the powers of luminosity are largely developed in this sex the emission of the light is usually of an intermittent flashing type. It has been noticed in various parts of the world that these flashing males tend to congregate in large companies, and that all the individuals of one of these gatherings will flash in concert. All the fireflies around one tree or group of trees, for instance, will flash together, while those around a neighbouring tree will be pulsating to a different time. This feature has been observed of a European species of Luciola (though Mr. Main and myself were unable to detect anything of the sort with *L. italica* at Lugano), of an Indian lampyrid, genus not stated, and of the genus Aspidosoma in South America. The American species of Photinus and Photuris do not seem to possess the habit.

The exact reason of this flashing in concert, or the method by which it is brought about, have not been ascertained. It has been suggested that the light is not really intermittent in character, but merely appears so owing to its being alternately masked and exhibited by movements of the creature's body, and that a slight puff of wind might perhaps affect all the members of a company and cause them all to conceal their lights at once. Though this explanation of the intermittent character of the light applies well enough to Pyrophorus, an insect we shall shortly consider, it is certainly not applicable to these Lampyridæ. It is true the light is not absolutely extinguished between the flashes, but it is so diminished as to become practically dark; moreover, the flashing in unison is too regular to be caused by chance puffs of wind. A more probable explanation of the phenomenon is that each flash exhausts the battery, as it were, and a period of recuperation is required before another flash can be emitted. It is then conceivable that the flash of a leader might act as a stimulus to the discharge of their flashes by the other members of the group, and so bring about the flashing concert by the whole company.

The physical and chemical nature of the light of these insects have been the subject of numerous investigations. Though often spoken of as "phosphorescent," the light has nothing whatever to do with the oxidation of phosphorus.

The most recent conclusions are those of Dubois, and were summarised by him in a communication to the Zoological Congress at Monaco in 1913. He finds that the mechanism for the production of light is the same throughout for both plants and animals, and is the result of the action of an oxidising zymase upon an organic proteid product in the presence of water. In the case of luminous insects the proteid, which he calls *luciferine*, is contained in the form of granules in the photogenic organ, while the zymase, to which he applies the name *luciferase*, is dissolved in the blood. The light is given off by the action of the luciferase on the luciferine as the blood passes through the luminous organs. This zymase can be replaced experimentally by a chemical oxidising agent such as permanganate of potash, lead dioxide, hydrogen dioxide, etc.

The luminous organs in these insects are found on dissection to be abundantly supplied with tracheæ, which open by means of very large spiracles. It is probable that by opening or closing these spiracles the insect is able to regulate the supply of oxygen to the luminous organs, and so in some degree to control the emission of light.

Though in many species the flashing of the male is so regular as to suggest its being due to reflex rather than to voluntary action, yet in the female the light appears to be more under the control of the insect. In many species the light may be emitted after the death of the insect, but in the case of males of the flashing species the light is then constant instead of intermittent and less intense than in life. While searching for the females of *Luciola italica*, I was several times deceived by the constant faint light of a dead firefly caught in a spider's web near the ground.

Another group of beetles the light-giving properties of which have caused them to be very widely known—at any rate by name—are the "fireflies" of tropical America, Pyrophorus. These must not be confused with the "fireflies" of Italy and southern Europe, which, as I have said, are really winged glow-worms allied to the lightning-bugs of the United States. The fireflies of tropical America and the West Indies, the creatures that the local belles wear in their hair, and about their persons, as a kind of living jewelry, known locally as Cucujos, belong to a very different family, the Elateridæ, or skip-jacks. They are considerably larger than the glow-worms, and their light organs are differently situated. The most obvious are a pair of large yellowish spots on the thorax, one near each of the posterior angles. If the beetle is examined alive, these spots, the "eyes" as they are called, will at first be quite dull and opaque; but when the insect is handled they will soon be observed to kindle, the glow increasing gradually in intensity until it reaches its maximum. This light is only emitted by the firefly when stimulated by some excitement, such as that caused by handling, and glows steadily so long as the excitement continues; as this wanes the light gradually dies away.

When the insect is on the wing the light seen is

not that emitted from these eye-spots, but originates from another light organ at the base of the abdomen. This organ is usually concealed between the abdomen and thorax, and is only exposed when the elytra are open so that the abdomen can be bent back. The light is of a redder, or yellower, colour than that emitted from the thoracic spots; and is intermittent instead of continuous, the flashes being caused by slight movements of the abdomen, whereby the light is alternately concealed and exhibited. The bionomic value of the light in these insects is not at all understood, but it does not seem to have any sexual function in this case.

The larvæ of these fireflies are also luminous. They are of typical elaterid form and live in rotten wood. In the young larvæ the light is emitted from the junction of the head with the body, but in the older larvæ it is emitted also from the junctions of the segments all along the body. The eggs also are stated to be luminous.

Various beetles of other families have been recorded as luminous, but all these records want confirmation, and some of them were certainly only accidental.

To sum up, nearly all the cases of luminous insects, and *all* those that are in any way well known and common, belong to the order Coleoptera, and even here almost entirely to the family Lampyridæ. An exception to this statement is found in the elaterid genus Pyrophorus, but other records all require confirmation. In the Lampyridæ the light plays an important part in securing the mating of the sexes, but its functions in other luminous beetles have not been satisfactorily explained.

In other orders of insects luminosity is rarely met with, at any rate in the normal condition of health; little or nothing is known of the part that it plays in the life of the animal; indeed its very existence, apart from what we may call accidental causes, is usually more or less problematical.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Romanes lecture—subject, "Science and the Great War"—was delivered by Prof. E. B. Poulton on December 7 before a large audience, which followed with marked interest and frequent applause the scathing indictment brought by the lecturer against the ruling powers of this country for their neglect of the teachings of science with regard to the conduct of the war. Prof. Poulton showed how by their refusal to benefit by the expert knowledge which might have been at their command for the asking, the Government had actually played into the hands of the enemy. This was especially apparent in the case of the materials for the manufacture of high explosives and in that of the importation into Germany of foodstuffs. The evil had to some extent been stopped, thanks, in the matter of cotton, to agitation by the Press; but it was still far from being at an end. The most deadly kind of war was one waged by a ruthless enemy employing to the full all the resources of modern science. Such an enemy we were now being called on to face, and our only hope of success lay in using those means which were ready to our hands if the authorities could be induced to apply for information and assistance in the proper quarters.

SHEFFIELD.—At the annual meeting of the court of governors of the University, it was announced that one outcome of the war was the establishment of a department in the scientific teaching of glass-making. The industry, an important one for the rougher kinds of work in south Yorkshire, had previous to the war to cope with serious German competition. The time is suitable to encourage this industry when it is relieved from German rivalry, and it is hoped that the University's efforts will be directed towards the finer kinds of glass work in which this country did but little in the past. A lecturer and a demonstrator in glass manufacture have already been appointed.

The great demand for medical men and the undesirability of discouraging suitable students, especially women, has resulted in the University deciding that Latin is no longer required as a subject in the matriculation examination for the medical degree. The new regulation continues until the University shall otherwise determine.

THE list of past and present students and staff of the Imperial College of Science and Technology serving with H.M. Forces, issued in May last, has been corrected so far as possible up to May 27. An analysis of the roll gives the total in connection with each of the constituent colleges. The grand total of present and past students and members of the staff was, in the case of the Royal College of Science, 161, the Royal School of Mines, 305, and the City and Guilds (Engineering) College, 719, being 1185 in all. Of this total 376 were present students, 739 past students, and 70 members of the staff, 715 of the total being officers.

As has been already noted in these columns, Columbia University received by the will of the late Mr. A. F. Eno the residuary estate. It is now announced in *Science* that Columbia University also receives a reversionary interest in certain bequests, and bequests of 50,000*l.* each are made to New York University, the American Museum of Natural History, and the Metropolitan Museum of Art. Our contemporary also records that Mr. and Mrs. Norman W. Harris, of Chicago, have increased their gift of 5000*l.* to Mount Holyoke College made at the time of the seventy-fifth anniversary, to 10,000*l.*, for the endowment of the chair of zoology.

THE annual meeting of the Mathematical Association will be held on Wednesday, January 5, at the London Day Training College, Southampton Row, London, W.C. The following addresses will be given:—(1) The aims of education, a plea for reform, (2) The allowance for the earth's rotation in the theory of projectiles, Prof. A. N. Whitehead; The results of an investigation into the degree of accuracy that may be expected in simple arithmetical work in boys' schools, G. W. Palmer. There will be a discussion on (*a*) the use of mathematical tables in schools, and (*b*) desiderata in a book of such tables for school use, to be opened by Mr. A. Lodge.

IN a recent publication of the Department of Agriculture and Technical Instruction for Ireland (Dublin, 1915) Mr. E. P. Barrett deals with suggestions for the teaching of the first year's syllabus in experimental science in secondary schools. The proposals mainly refer to the use of graphs, with special application to the experimental determination of the relations between connected quantities. Unfortunately, however, the author overlooks the necessity of drawing graphs between quantities of the same kind in their proper proportions, and his figure makes the circumference of a circle appear to be about one and a half times its diameter, a mistake for which hundreds of marks are probably lost every year by examination candidates.

A COPY has reached us of the prospectus of the School of Tropical Agriculture, Peradeniya, Ceylon, of which the Director of Agriculture is the Principal. The school is situated close to the Botanic Gardens, and is intended for boys of seventeen years of age and over who have passed the eighth standard of the

Education Department or its equivalent. An elaborate scheme of work is set out for the course of instruction, including chemistry, plant diseases, agricultural engineering, animals, co-operation, etc., which is to cover a year of three terms. Three examinations are arranged for during the course, and a certificate is to be granted at its conclusion. If the students succeed in gaining a sound knowledge of even a quarter of the subjects detailed in the prospectus, the school may perhaps be considered to justify its existence, but it would seem impossible in so short a time as a year for a real grasp of tropical agriculture to be gained by the students. Lectures and demonstrations are to be given by the staff of the Agricultural Department, an arrangement which bids fair seriously to hamper the legitimate work of the agricultural officers if the syllabus is to be followed and not to be merely a grandiose paper scheme.

THE Appointments Board of the University of London was appointed by the Senate in 1909 to assist graduates and students of the University to secure appointments. During the past academic year the Board has secured more than 100 appointments for its clients. In the last report of the Board to the Senate attention is directed to the special assistance which has been given recently, in filling the vacancies caused by men enlisting, by the appointment of women graduates to them. The services of educated women are proving of great value in boys' schools, in business offices of every kind, and in the various Government departments. The secretary to the Appointments Board, University of London, will be glad to assist employers by giving names of suitable women graduates still disengaged.

THE Cambridge University Calendar for the year 1915–16 has now been issued by the University Press. The present edition contains an index of complete degrees *honoris causa*, in addition to the index of titular degrees which appeared last year. A separate section on the war has also been added, and an annotated list of presidents of the union, from the foundation of the society in 1815, appears in the appendix. In other respects the edition of last year has only been brought up to date. Since the section on the war was sent to press, a supplementary war list has been issued by the *Cambridge Review*. From this it appears that the total number of members of the University on service is now 10,250, and of these nearly one in seven is numbered among the killed, the wounded, or the prisoners, while more than 300 have won distinctions in the field.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 2.—Sir J. J. Thomson, president, in the chair.—W. H. **Young**: Note on the existence of converging sequences in certain oscillating successions of functions.—S. A. **Shorter** and S. **Ellingworth**: The emulsifying action of soap—a contribution to the theory of detergent action. (1) The hydrolysis alkali in a soap solution is capable of assisting in the formation of the soap absorption layer by interacting with free fatty acid in an oil. (2) The "surface activity" of the hydrolysis alkali, in case of oils containing small amounts of free fatty acid, is much smaller than that of the undecomposed soap. (3) Surface activity of free alkali in soap solution is less than that of the same concentration of alkali in water. (4) Addition of alkali to soap solution increases surface activity of soap. This effect is much too large to be explained by suppression of hydrolysis. It is suggested that the effect is due to increase in colloidal nature of "semi-colloidal" soap solution.—P. E. **Shaw**: The Newtonian constant of gravitation as affected by temperature. (1) It has been found possible (*a*) to obtain consistent cycle readings in a gravitational experiment of the Cavendish type, even though the large masses are maintained for hours above 200° C., while the small masses remain at ordinary temperatures; (*b*) to carry on this investigation in the centre of a city at any time by day or night, in spite of tremors and the special disadvantage of having the torsion balance in a vacuum. (2) The conclusion reached is that there is a temperature effect of gravitation. When one large mass attracts a small one the gravitative force between them increases about 1/500 as temperature rises from, say, 15° to 215°. Provisionally, the result is stated as $+1{\cdot}2+10^{-5}$ per 1° C. The readings are not steady enough to justify the statement that there is a *linear* relation for G/θ. Time may be a factor in the effect, but the net result has not been shaken by a long series of tests. (3) The above result, though new, is not entirely unsupported by other experiments, for previous work yields indirect evidence of a positive temperature-coefficient. The weight experiments of Poynting and Phillips, which yielded negative results, are not strictly comparable with the author's. (4) As a by-product of these experiments, it was found that silver bars of the highest purity, after being heated to 130° C. and kept in a strong magnetic field, were permanently, though weakly, magnetised, and that the coercivity was considerable.—G. I. **Taylor**: Skin friction of the wind on the earth's surface. The amount of the skin friction between the wind and the surface of the earth is calculated from observations of wind velocity at different heights above the ground. It is found that the skin friction force acting on unit area of the ground is proportional to the square of the wind velocity, and that its actual value is of the same order as, though probably smaller than, that found by experimenting with flat plates and pipes in the laboratory. The object with which the investigation was undertaken was to find out whether the skin friction on a small surface is nearly equal to that on a very large surface; but if it were assumed that this is the case, the method employed furnishes an explanation of the fact that the surface wind is, on the average, roughly about half the gradient wind in the latitude of the British Isles.

Society of Public Analysts, December 1.—Mr. A. Chaston Chapman, president, in the chair.—W. **Partridge**: The "presumptive *coli* test" on unchilled water. The author points out that if positive results are ignored and negative results only considered, the "presumptive *B. coli* test" often usefully supplements the ordinary chemical analysis of unchilled water.—E. R. **Bolton**: Notes on methods of analysing oleaginous seeds and fruits. It is shown that the errors in the estimation of oil in oleaginous seeds and fruits (copra in particular) are due rather to "sampling" than to actual analysis. Methods of sampling, grinding, and analysis were demonstrated to show that, while the oil in copra could be estimated with great accuracy by the methods given, a departure from the procedure would be liable to cause considerable error.

MANCHESTER.

Literary and Philosophical Society, November 16.—Prof. S. J. Hickson, president, in the chair.—Dr. G. A. **Hemsalech**: The spectra emitted by metal vapours in the explosion region of the air-coal-gas flame. The author reviewed the work done on Bunsen-flame spectra by M. de Watteville, and on the different flame spectra of calcium and iron by Hemsalech and

de Watteville. He described a simple and convenient burner by means of which the various flame phenomena can be readily subjected to spectroscopic observation and experiment. Photographs were shown to illustrate the changes in the Swan spectrum emitted by the explosion region of flames on passing from rich to very weak gas mixtures. For very weak mixtures the ordinary Swan spectrum disappears, and another band spectrum develops. Some experiments were then shown to demonstrate the action of electric fields on the flames of weak gas mixtures charged with sodium vapour. The great sensitiveness of such flames in a longitudinal field was illustrated in several ways, and, in particular, it was shown that when the gas mixture had become so weak that in the absence of the electric field it would no longer ignite, it would do so immediately on the field being restored.

EDINBURGH.

Royal Society, November 15.—Dr. J. Horne, vice-president, in the chair.—Dr. H. **Drinkwater**: Preliminary notice of a family showing inherited abnormal segmentation of the digits of both hands. The chief anatomical peculiarities were:—(1) The index, middle, and little finger much reduced in length, the ring finger projecting far beyond the others; (2) radiography shows (*a*) that the hands belong to the minor brachydactylous type, with abortive but separate middle phalanx; (*b*) that the base of the proximal phalanx of the index finger was very oblique, instead of being at right angles to the length of the bone, a condition shown to be due to the interposition of an extra bone of triangular shape; (*c*) that there are frequently two bones in place of the normal single proximal phalanx in the middle finger, the extra one being in series with the extra bone in the index finger. The condition had been hereditary in the family for (at least) four generations, and was transmitted on Mendelian lines.—Prof. Cossar **Ewart** and Miss Dorothy **Mackenzie**: The moulting of the king penguin. By means of a beautiful and complete series of photographs taken by Miss Mackenzie at the Edinburgh Zoological Park, the whole succession of stages in the process of moulting was clearly demonstrated. Other connected peculiarities of feather growth were also described.

DUBLIN.

Royal Dublin Society, November 23.—Prof. W. Brown in the chair.—Prof. W. **Brown**: The subsidence of torsional oscillations and the fatigue of iron wires when subjected to the influence of alternating magnetic fields of frequencies up to 250 per second. In the subsidence of torsional oscillations and in the fatigue of iron wires under the influence of alternating magnetic fields it was found that the time taken to effect the maximum fatigue was inversely proportional to the frequency of the applied alternating magnetic field, and that the maximum value of the fatigue was the same for frequencies 50 to 250 per second. Increasing the frequency of the alternating magnetic field five times had very little effect on the subsidence of torsional oscillations.—P. E. **Belas** and Prof. M. **Hartog**: The path of a small permeable body moving with negligible acceleration in a bi-polar field. When a small pellet of paraffin wax containing iron dust is floated in glycerine in the vicinity of the poles of an electromagnet, certain curved paths are described by the pellet, which moves so as to include the maximum number of lines of induction. These paths were traced by focusing the image of the pellet on the ground glass of a camera fitted with a right-angled prism, and dotting in with a pencil the successive positions of the image. The curves were taken for similar and dissimilar poles.—T. G. **Mason**: Preliminary notes on the carbohydrates of the Musci. The wide divergence of opinion that prevails concerning the carbohydrates of the angiosperms has suggested that an investigation conducted among the Musci would be of interest, and might shed light on the subject of photosynthesis. Dextrose, levulose, and sucrose have been identified in the following species:—*Polytrichum commune*, *Sphagnum cymbifolium*, and *Thuidium tamariscinum*. Maltose was found in *P. commune* alone; it is found only when starch is present. Invertase was detected in *P. commune*, *T. tamariscinum*, *S. cymbifolium*, *Brachythecium rivulare*, and *Dicranus majus*. The distribution of diastase and maltase is dependent on the presence of starch. In *P. commune* and *S. cymbifolium* the hexoses are the chief form in which the carbohydrates are translocated from the leaves. In *S. cymbifolium* sucrose is the first sugar to be formed in appreciable quantities after the application of light.—J. J. **Dowling**: A new form of very high resistance for use with electrometers. To measure very small currents by a steady deflection method, using an electrometer, very large resistances are required. The equivalent to such a large resistance may be obtained by alternately charging and discharging a condenser, as in Siemen's method for measuring small capacities. Assuming that the electrometer system has a capacity large compared with the condenser (*c* farads), which is intermittently connected to it (*n* times per second), the potential (V), to which the electrometer system rises, when a current (*i*) is flowing in, is given by the equation $ncV=i$. The arrangement is thus equivalent to a resistance $R=1/nc$ ohms. Values of R up to 10^{16} ohms have been worked with, but greater values may be obtained. If the condenser is not simply discharged each time, but charged with the opposite sign, the method may be used as a "zero" or a "compensation" method.

PARIS.

Academy of Sciences, November 22.—M. Ed. Perrier in the chair.—L. **Maquenne**: The action of saccharose on the cupropotassic solution. In the action of alkaline copper solutions upon invert sugar, the reducing power is mainly dependent upon the proportion of alkali and only slightly affected by the proportion of copper. But with cane-sugar the reverse is the case; the action appears to be one of oxidation by the copper salt, and is not a result of hydrolysis by the alkali.—L. **Guignard**: New observations on the formation of pollen in certain Monocotyledons. In all the species of Iridaceæ examined the mode of division of the mother pollen cell resembles that typical in the Dicotyledons.—A. **Blondel** and F. **Carbenay**: The forced oscillations of an oscillating system with discontinuous damping.—P. **Carrasco**: The structure of the line spectrum of the solar corona. A photograph of the solar corona taken during the eclipse of August 21, 1914, gave a red line as the most prominent in the spectrum (λ 6374). It is now shown that this line is included in Nicholson's series, $\lambda=(18{\cdot}5397-1{\cdot}1029n)^2$, n having the values 0, 1, 2, 3, etc.—J. **Haag**: The calculation of time.—Gabriel **Sizes**: The resonance law of sonorous bodies.—L. **Tschugaeff** and L. **Tschernijaeff**: The complex hydroxylamine compounds of bivalent platinum. An account of the preparation of all the members of the series $Pt(NH_3.OH)_n(NH_3)_{4-n}X^2$, of which only the extremes, $Pt(NH_3)_4X_2$ and $Pt(NH_2.OH)_4X_2$ were previously known.—M. **Dalloni**: The upper Miocene in the west of Algeria; the Hipparion layers of Tafna.—P. W. **Stuart-Menteath**: The lignites of Bidart-Biarritz.—Louis **Lapicque**: New methods for electrodiagnosis.—Charles **Nicolle** and Ludovic **Blaizot**: New researches on exanthematic typhus. The virus can be preserved indefinitely by transmission through guinea-pigs. During the fever, the unknown micro-organism of typhus is present in all the organs of the body, even when free from blood.—E. **Vasticar**: The terminations of the acoustic nerve.—H. **Colin**: The sterilisation of

water by carbonic acid under pressure. Water containing the Eberth bacillus is sterilised by carbonic acid in 20 hours under 10 kg. pressure, 8 to 20 hours under 15 kg., 3 to 9 hours under 20 kg., and 3 to 6 hours under 25 kg. pressure. Data for other micro-organisms are also given.

BOOKS RECEIVED.

Mimicry in Butterflies. By Prof. R. C. Punnett. Pp. vi+188+plates xvi. (Cambridge: At the University Press.) 15s. net.

A Student's Book on Soils and Manures. By Dr. E. J. Russell. Pp. ix+206. (Cambridge: At the University Press.) 3s. 6d. net.

Soils and Plant Life as related to Agriculture. By Prof. J. C. Cunningham and W. H. Lancelot. Pp. xx+348. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5s. net.

The Cambridge University Calendar for the Year 1915–1916. Pp. xxvi+1069. (Cambridge: At the University Press.) 7s. 6d. net.

A Course of Modern Analysis. By Prof. E. T. Whittaker and Prof. G. N. Watson. Second edition. Pp. 560. (Cambridge: At the University Press.) 18s. net.

U.S. Bureau of Education. Bulletin No. 27. Whole No. 654. Opportunities for Foreign Students at Colleges and Universities in the United States. Pp. 213. (Washington: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. lxv., No. 3. Hodgkins Fund: A Study of the Radiation of the Atmosphere. By A. Angström. Pp. v+159. (Washington: Smithsonian Institution.)

Homer and History. By Dr. W. Leaf. Pp. xvi+375. (London: Macmillan and Co., Ltd.) 12s. net.

Instinct and Intelligence. By N. C. Macnamara. Pp. 216. (London: H. Frowde and Hodder and Stoughton.) 6s. net.

Contributions from the Jefferson Physical Laboratory of Harvard University for the Years 1913 and 1914. Vol. xi. (Cambridge, Mass.)

Department of Education, Ontario. Educational Pamphlets, No. 9: Laboratory Accommodation in Continuation and High Schools and Collegiate Institutes. By G. A. Cornish. Pp. viii+144. (Toronto: L. K. Cameron.)

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 9.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Respiratory Process in Muscle; and the Nature of Muscular Motion: Dr. W. M. Fletcher and Prof F G Hopkins.

MATHEMATICAL SOCIETY, at 5.30.—The Vibrations of a Special Type of Dissipative System: H. Jeffreys.—Diffraction by a Wedge: F. J. W. Whipple.—Some Applications of the Two-three Birational Space Transformation: T. L. Wren.—The Circles which Touch the Escribed Circles of a Triangle: T. C. Lewis.

OPTICAL SOCIETY, at 8.—Improvements in Prismatic Compasses, with Special Reference to the Creasey-Osborne Patent Compass: A. Hughes.

FRIDAY, DECEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) The Accuracy of Hagen's Chart of T Herculis, and on a possible new Variable Star; (2) Note on the number of faint stars with large Proper Motions: F. A. Bellamy.—The Theory of Star-streaming and the Structure of the Universe: J. H. Jeans.—(1) The Viscosity of the Earth, second paper; (2) The Figure of the Earth; a reply to Mr. Hinks: H. Jeffreys.—Note on Comet Mellish (1915a), 1915, October 4: F. Henroteau.—Preliminary Paper on recent lists of new Double Stars: E. Doolittle.—The Distribution of Stars in Globular Clusters: H. C. Plummer.—*Probable Papers:* The Magnitude Scales of the Astrographic Catalogue, ninth note: The Toulouse and Cape Magnitudes, with further remarks on the Obscured Region in the Sky as a Spiral: H. H. Turner.—Baxendell's Observations of Variable Stars, fifth instalment; No. 13, T Herculis and No. 14 R Leonis: H. H. Turner and Mary A. Blagg.

MALACOLOGICAL SOCIETY, at 7.—Note on the Oligocene of Tampa, Florida, the Panama Canal Zone, and the Antillean Region: Dr. W. H. Dall.—Description of Two New Species of Angasella: G. K. Gude.

MONDAY, DECEMBER 13.

ROYAL SOCIETY OF ARTS, at 4.30.—Optical Glass. III.: Dr. W. Rosenhain.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Work of the Peru-Bolivia Boundary Commission: Sir T. H. Holdich.

VICTORIA INSTITUTE, at 4.30.—The Movements of the Stars: Prof. A. S. Eddington.

SOCIETY OF ENGINEERS, at 5.30.—Annual General Meeting.

TUESDAY, DECEMBER 14.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Evolution of the Earliest "Chelles" Palæoliths from the Rostro-Carinate Implements: J. Reid Moir.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—"James Forest" Lecture, Electrical Railways: H. M. Hobart.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Recent Developments in Electric Incandescent Lamps in Relation to Illuminating Engineering: Prof. J. T. Morris.

WEDNESDAY, DECEMBER 15.

ROYAL SOCIETY OF ARTS, at 4.30.—Carillons and Carillon Playing: J. J. Denyn and W. W. Starmer.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Incidence of Bright Sunshine over the United Kingdom during the thirty years, 1881–1910: F. J. Brodie.—Remarkable Cloud Phenomena: Dr. W. Galloway.—South African Coast Temperatures: Dr. J. R. Sutton.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Use of Ultra-violet Light in Microscopy: J. E. Barnard.

GEOLOGICAL SOCIETY, at 5.30.—Deep-Boring for Coal at Little Africk, near Missenden (Bucks): Dr. A. Strahan.

THURSDAY, DECEMBER 16.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Jute Industry: C. C. McLeod.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Design of High-pressure Distribution Systems: J. R. Beard.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Nature and Formation of Sand Ripples and Dunes: W. J. Harding King.

LINNEAN SOCIETY, at 5.—The Structure and History of Play: The Floating Fen of the Delta of the Danube: Miss Marietta Pallis.—The Seed-mass and Dispersal of *Helleborus fœtidus*, Linn.: T. A. Dymes.—Sample of "Figured Ebony," with Specimens of Walking-sticks Manufactured from it by Messrs. Henry Howell & Co.: B. Daydon Jackson.—The Reproduction of Protodrilus: E. S. Goodrich.

FRIDAY, DECEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Engineering Colleges and the War: Dr. R. Mullineux Walmsley and C. E. Larard.

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